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ABSTRACT

This self-instructional booklet is designed to enable yellow fever control workers to identify the larvae of "Aedes aegypti." The morphological features of mosquito larvae are illustrated in this partially programed text, and the distinguishing features of "A. aegypti" indicated. A glossary is included. (AI)

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WORKBOOK ON

IDENTIFICATION OF AEDES AEGYPTI LARVAE

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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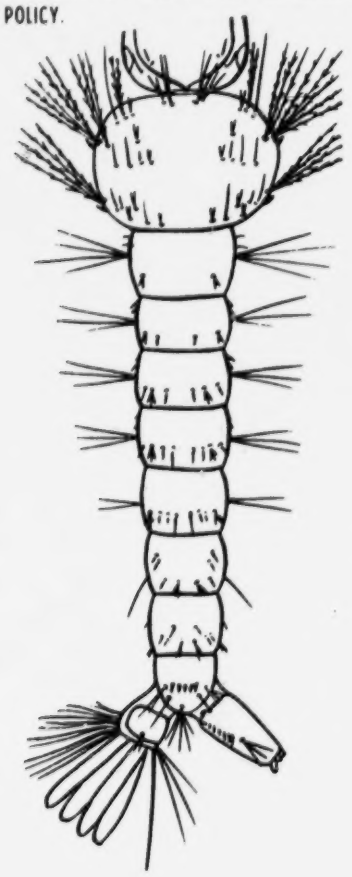

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WORKBOOK ON

IDENTIFICATION OF AEDES AEGYPTI LARVAE

by
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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Communicable Disease Center
Aedes aegypti Eradication Branch
Atlanta, Georgia
August 1964

INTRODUCTION

The program for the eradication of the yellow fever mosquito (*Aedes aegypti)* from the United States is based upon a carefully organized plan of attack involving five steps:

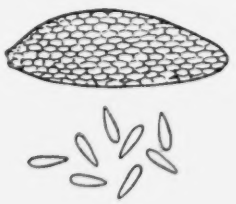
1. Inspection and collection of mosquito larvae in water-holding containers;
2. Determination of areas infested with *Aedes aegypti;*
3. Eradication of these mosquitoes through improved sanitation to eliminate the breeding places (tin cans, bottles, old tires, etc.) or residual spraying with insecticides of selected areas where the larvae occur;
4. Additional inspections to check on the presence (or absence) of *aegypti* following eradication measures; and
5. If the species is still present, additional residual sprayings, as necessary.

The importance of correctly identifying *Aedes aegypti* mosquito larvae, therefore, is of great importance in the overall operation of this Eradication Program.

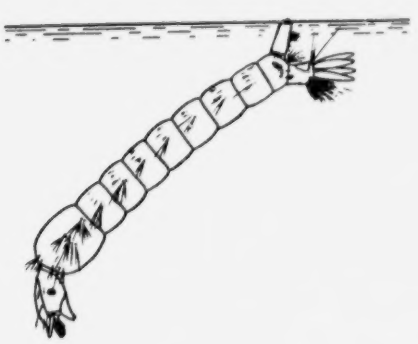
This workbook has been designed to teach basic information about the life cycle of mosquitoes, the two main types of mosquito larvae, and the principal characters used in identifying the three important genera *Aedes*, *Anopheles* and *Culex*. Most important of all, the book emphasizes the significant characters used in identifying *Aedes aegypti* and other species of mosquitoes commonly found in water-holding containers.

There are four stages in the life history of mosquitoes:

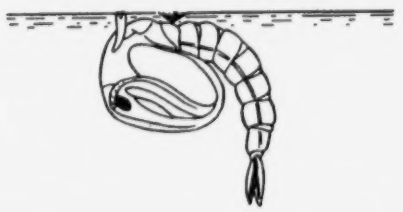
1. Egg



2. Larva



3. Pupa



4. Adult

The first three stages are aquatic; the fourth, or adult stage, is aerial. Among most species the adult females, but not the males, are bloodsucking.

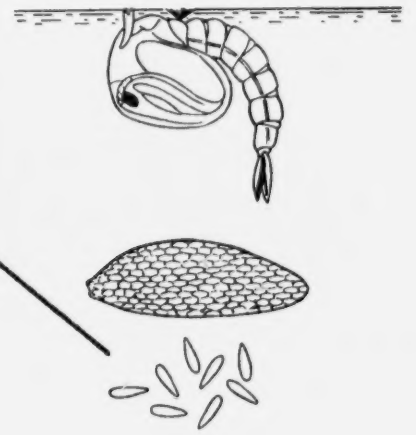
Test yourself: Draw a line from each name to the appropriate drawing.

1. egg

2. larva

3. pupa

4. adult

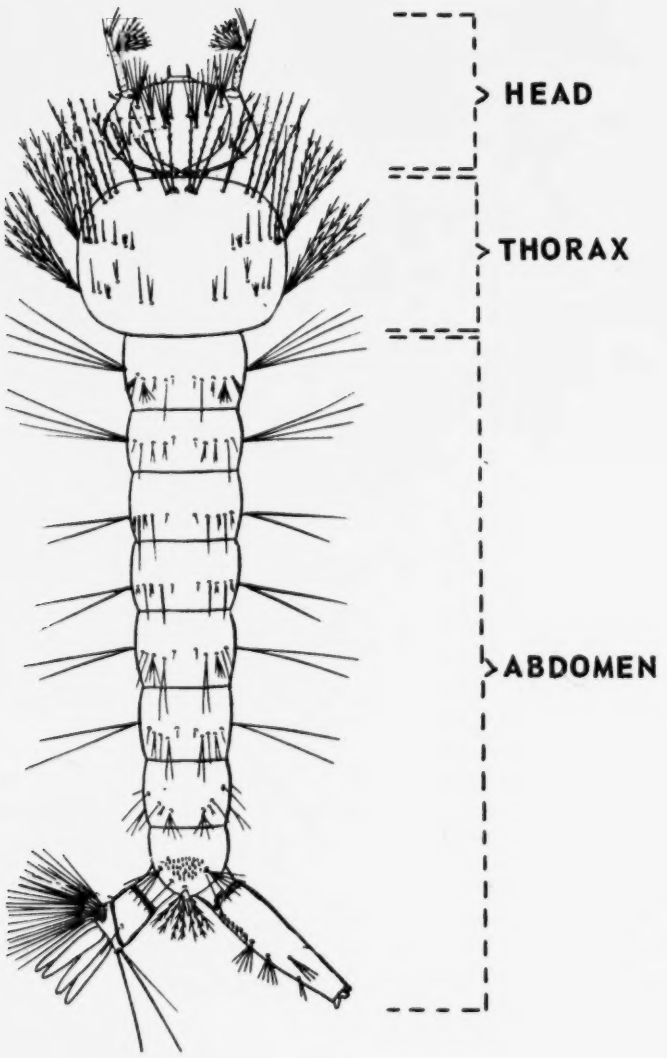


Mosquito larvae can be distinguished from all other aquatic insects by a combination of two characters:

1. They have no legs,

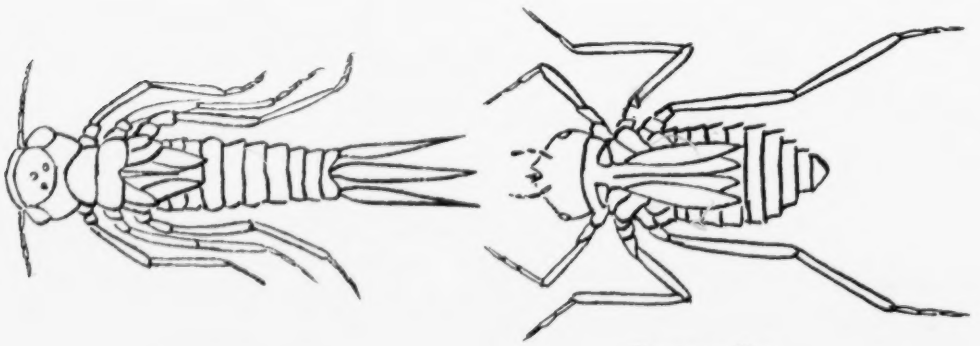
   and

2. The thorax is wider than the head or abdomen



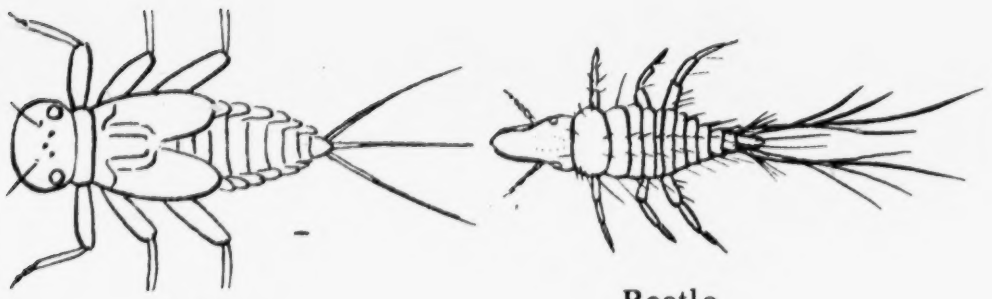
These are not mosquito larvae but are found commonly in collections of standing water.

These aquatic insects have legs on the thorax.



Damsel fly

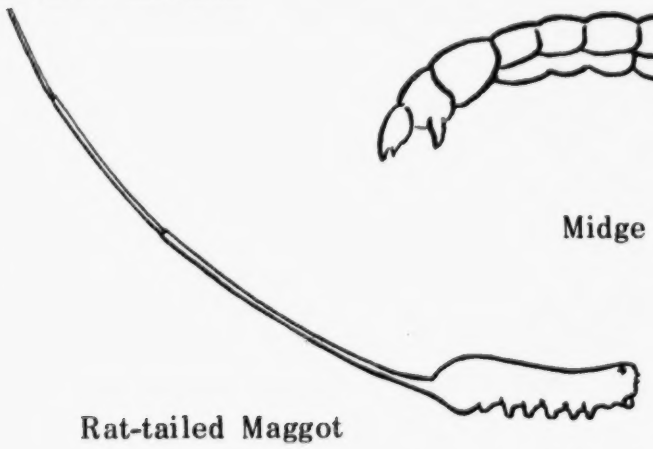
Dragonfly



May fly

Beetle

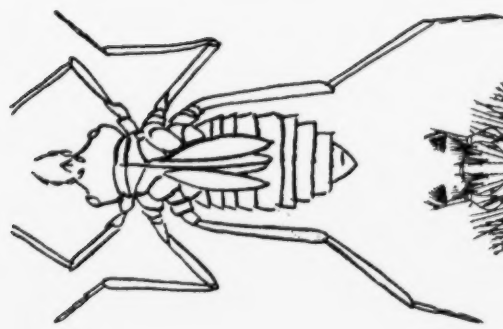
These aquatic insects have the thorax about as wide as the head or abdomen.



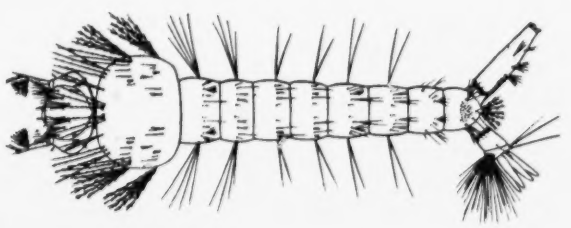
Midge Larva

Rat-tailed Maggot

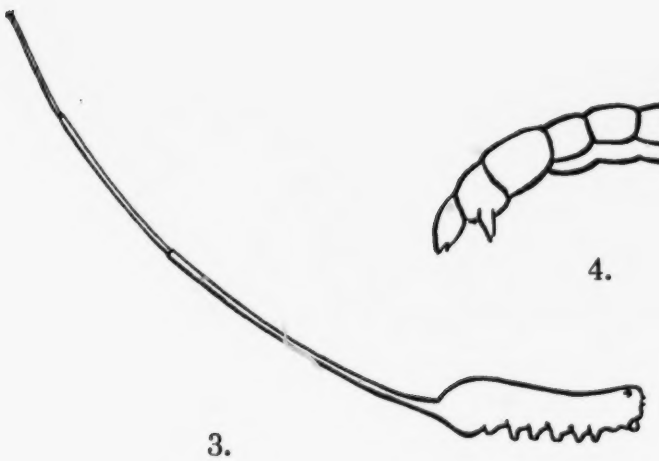
Test yourself: Circle the numbers of the specimens illustrated below that are mosquito larvae.



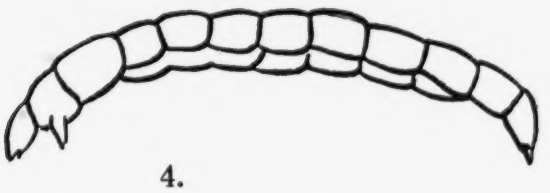
1.



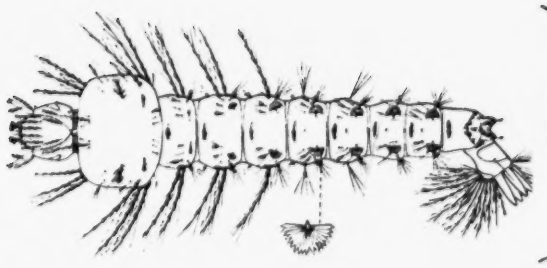
2.



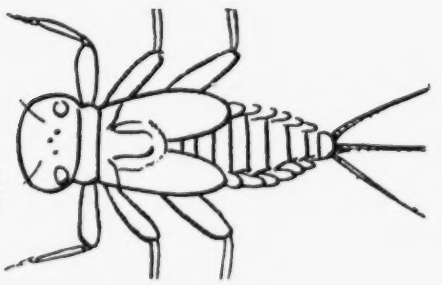
3.



4.



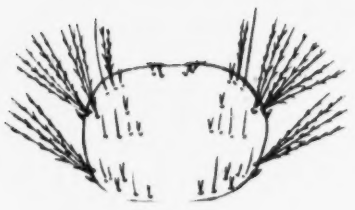
5.



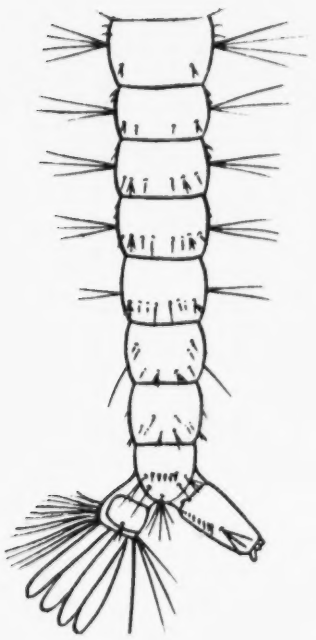
6.

The mosquito larva is divided into three body regions: head, thorax, and abdomen. Structures on each of these three body regions are used in identifying mosquito larvae.

HEAD

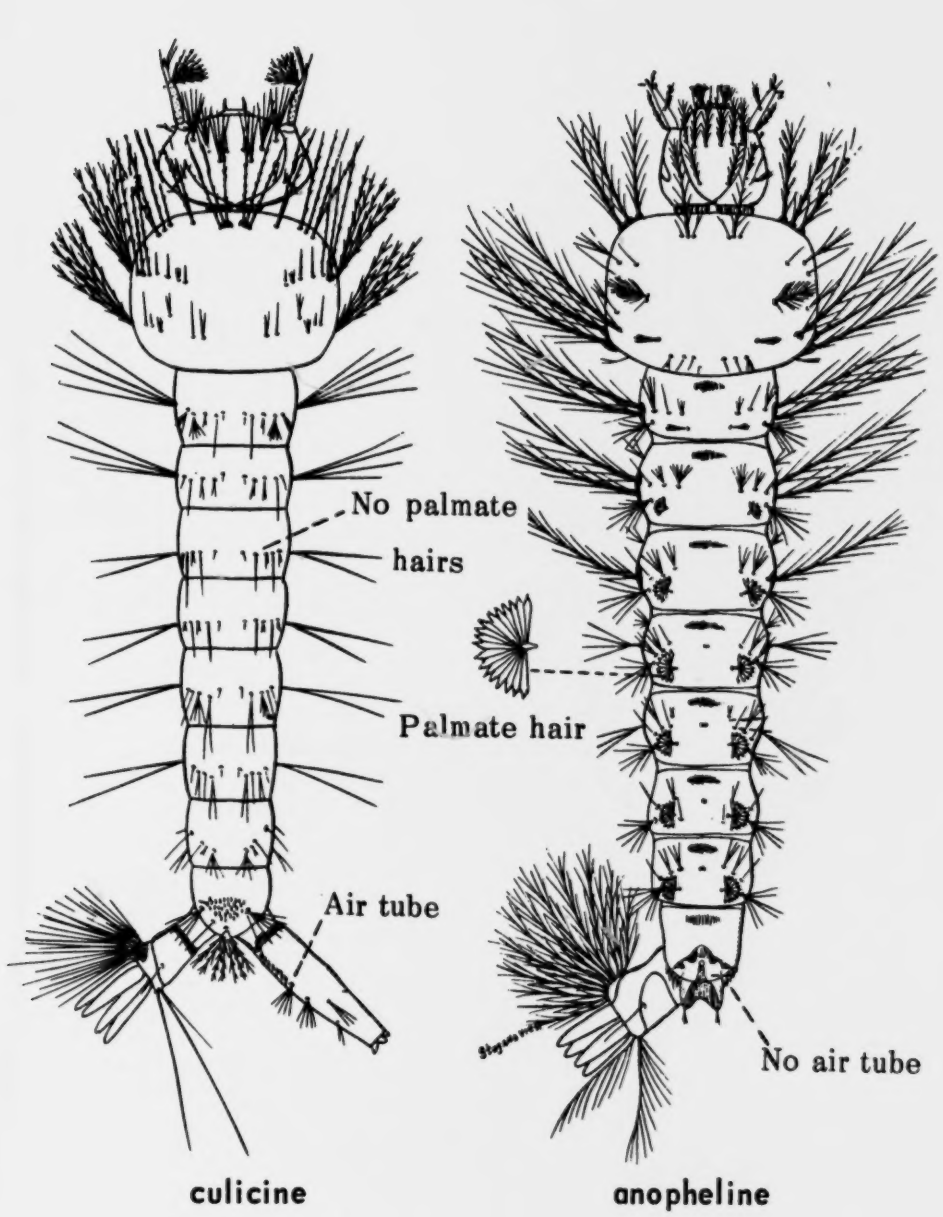


THORAX



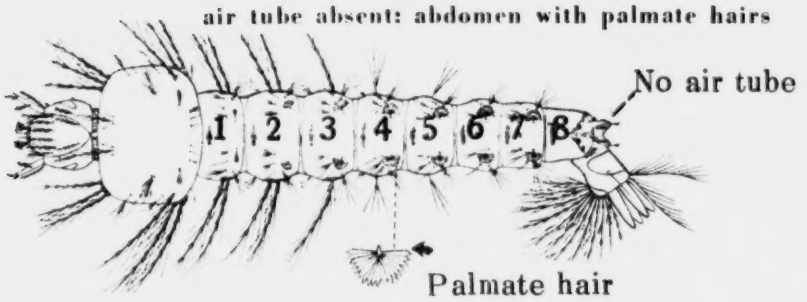
ABDOMEN

Mosquitoes are divided into two main types known as "anopheline" or "culicine." An anopheline mosquito larva has palmate hairs and no air tube; a culicine mosquito larva has no palmate hairs but does have an air tube.



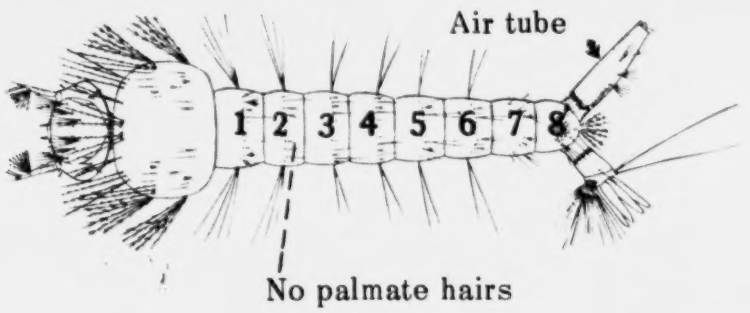
The **palmate hairs** (after the palm of the hand or a palm frond) are palm-shaped structures present on the abdomen of anopheline larvae and absent in culicine larvae.

air tube absent: abdomen with palmate hairs

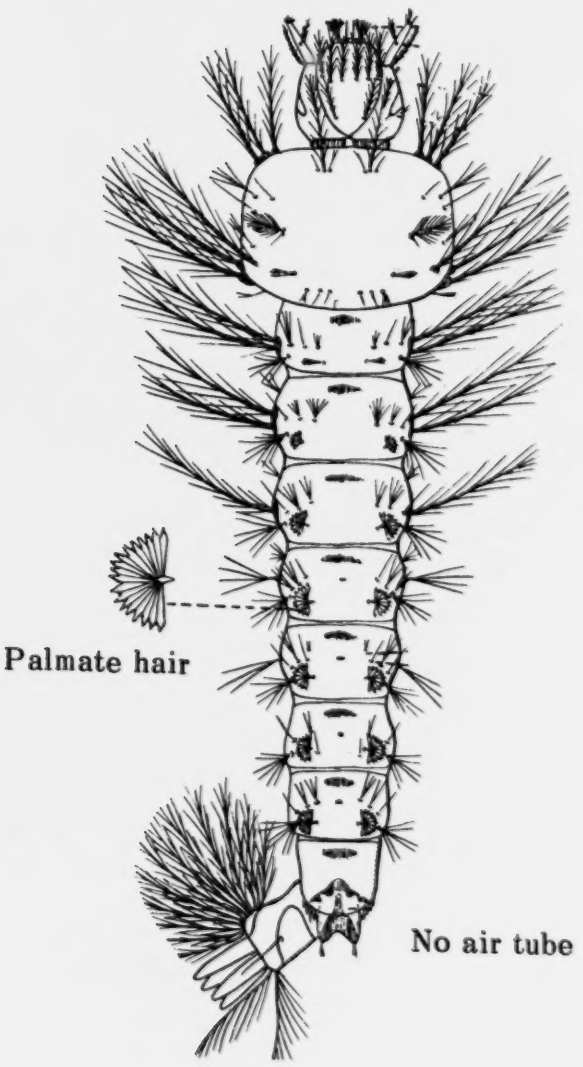


The air tube is a cylindrical structure arising from the eighth abdominal segment. It is present in the culicine larvae but absent in the anopheline larva.

air tube present: abdomen without palmate hairs



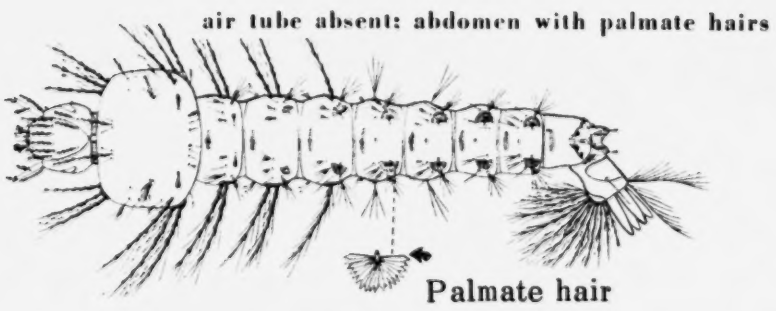
The malaria mosquito belongs to the group, or genus (plural – genera), named *Anopheles*. The term "anopheline" is derived from this name. Study the anopheline larva pictured here.



Malaria mosquito larva
(*Anopheles*) = "anopheline" mosquito larva

Remember these three facts to identify an anopheline, or malaria-mosquito, larva.

1. It lies parallel to the water surface.
2. It has no air tube.
3. It has palmate hairs which help keep the abdomen at the water surface.



Test yourself:

Mark out the wrong statement in (a) and (b).

The malaria mosquito larva can be identified in the field with the naked eye, for it

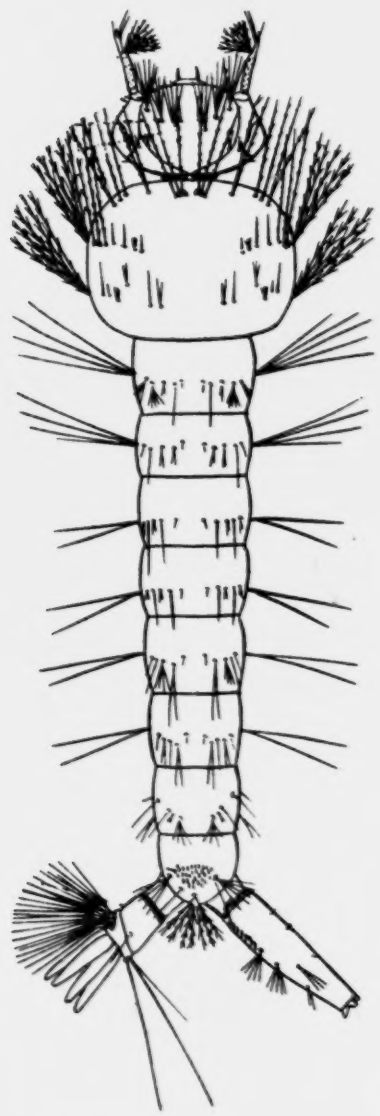
(a)
~~Hangs from the water surface.~~
Lies parallel with the water surface.

(b)
Has an air tube.
~~Does not have an air tube.~~

Fill in the blank in the statement below:

In the laboratory, with the aid of a microscope, you can see star-shaped structures, called _____, on some of the abdominal segments.

The term "culicine" mosquito comes from the genus name *Culex*, a well-known genus of pest mosquito. Study this drawing of a culicine larva.

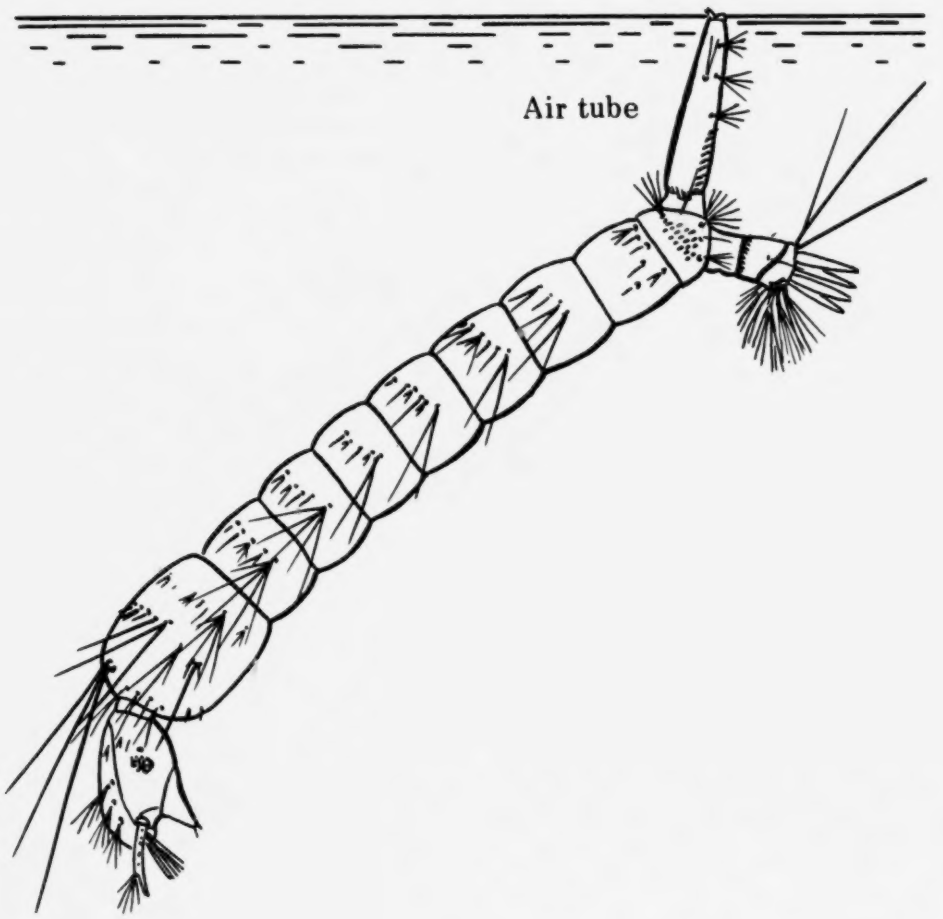


Pest mosquito larva

(*Culex*) = "culicine mosquito larva"

These characteristics will enable you to identify the larva of a culicine, or pest mosquito.

1. It hangs at an angle to the water surface.
2. It has an air tube.
3. It does not have palmate hairs.

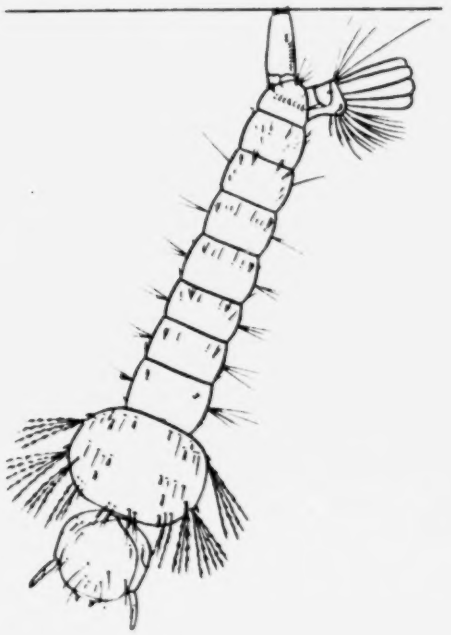


Test yourself: Culicine larvae can be identified by three characters:

1. _____

2. _____

3. _____



Test yourself:

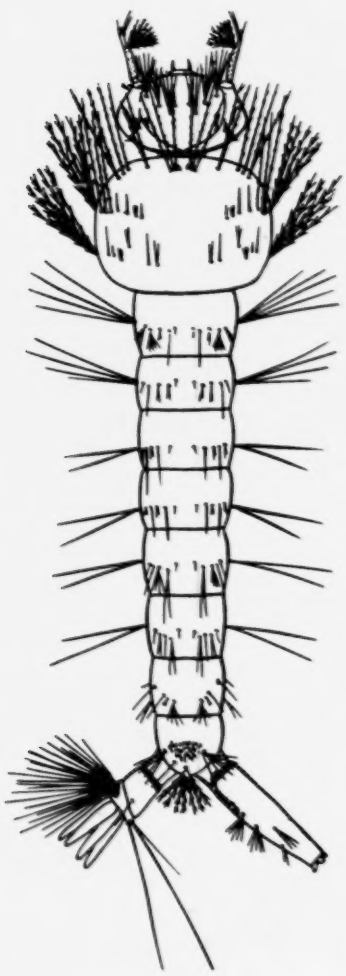
The two important types of mosquito larvae are called

1. _____ or _____

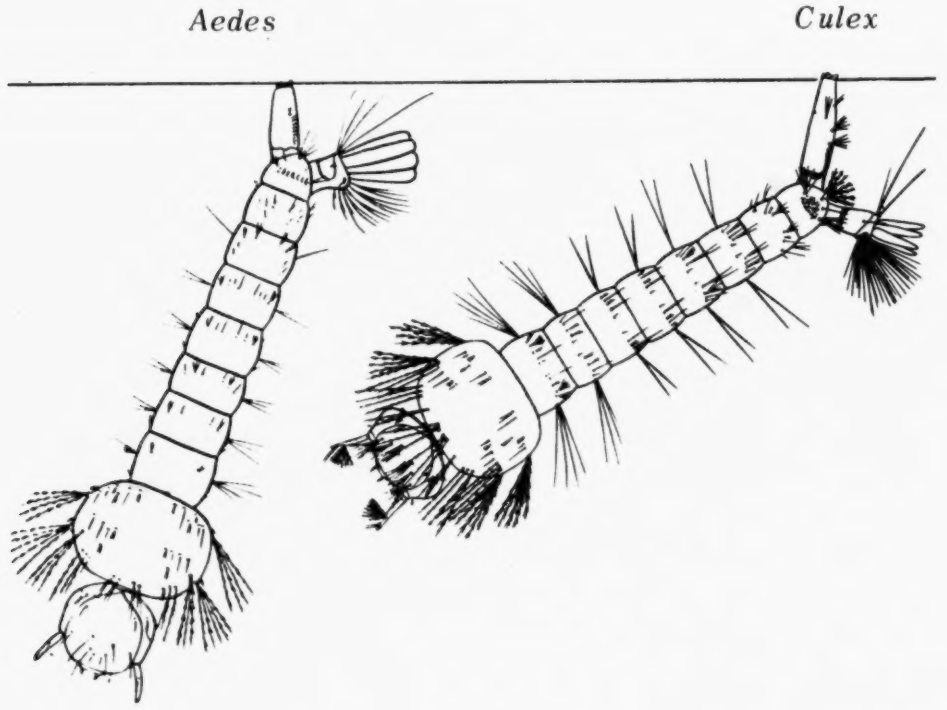
2. _____ or _____

Write the appropriate names over the larvae pictured.

_____ _____

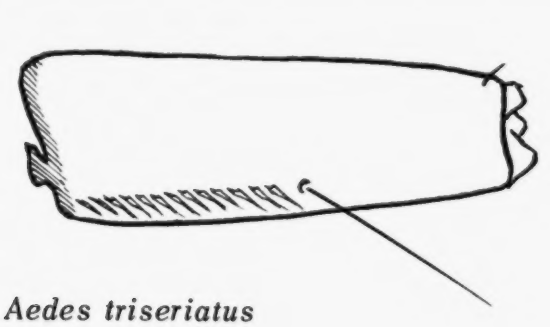


Culicine mosquitoes are divided into two important groups, or genera, called *Aedes* and *Culex*. There are many other culicine mosquitoes, including those in the genera *Mansonia, Psorophora, Toxorhynchites* and *Orthopodomyia*. Only *Aedes* and *Culex* are important to you here.

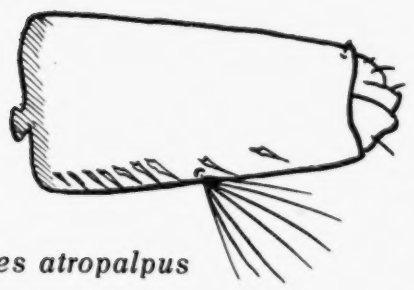


To tell *Culex* and *Aedes* larvae apart under the microscope, look for the hairs on the air tube. *Aedes* larvae have a single hair, or one two-branched hair tuft or one many-branched hair tuft on each side of the air tube.

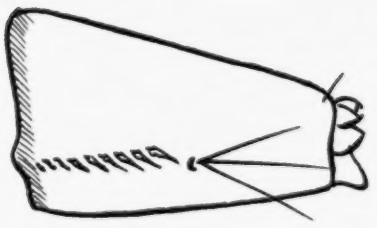
In the drawings here, note that when a hair tuft has two or more branches, all of the branches arise from the same socket.



Aedes triseriatus



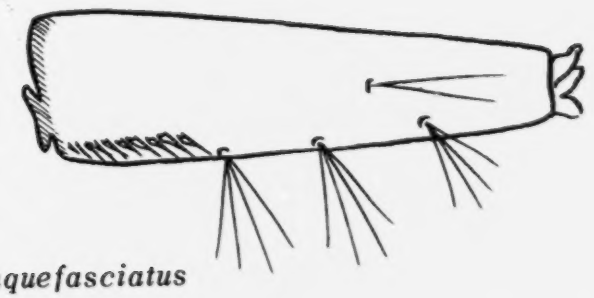
Aedes atropalpus



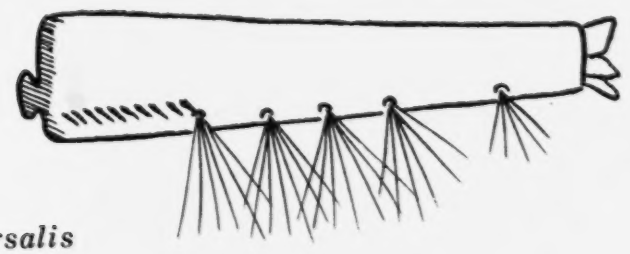
Aedes aegypti

Culex larvae have several single hairs, or several 2-branched or many-branched hair tufts, on each side of the air tube.

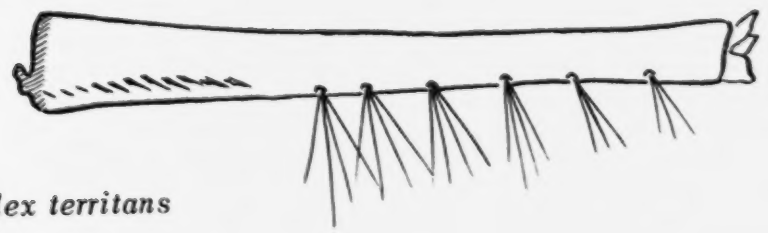
Culex restuans



Culex quinquefasciatus



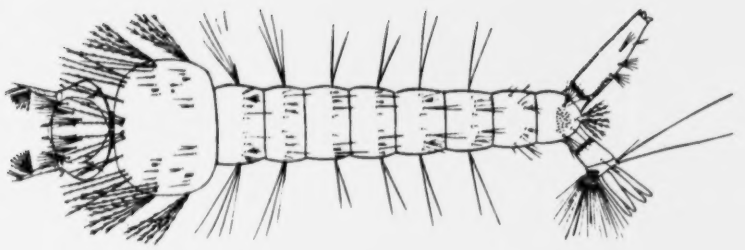
Culex tarsalis



Culex territans

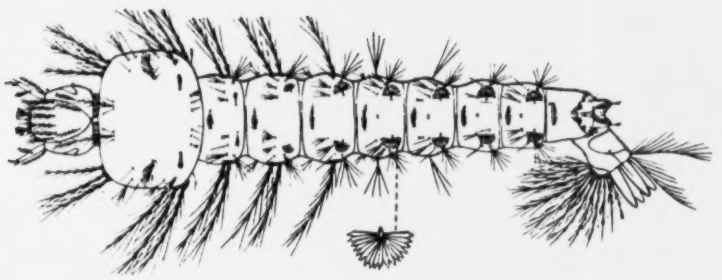
Test yourself:

Label the important structures used in identifying the two chief types of mosquito larvae illustrated below. What are the names of each type of larva?



_____

name

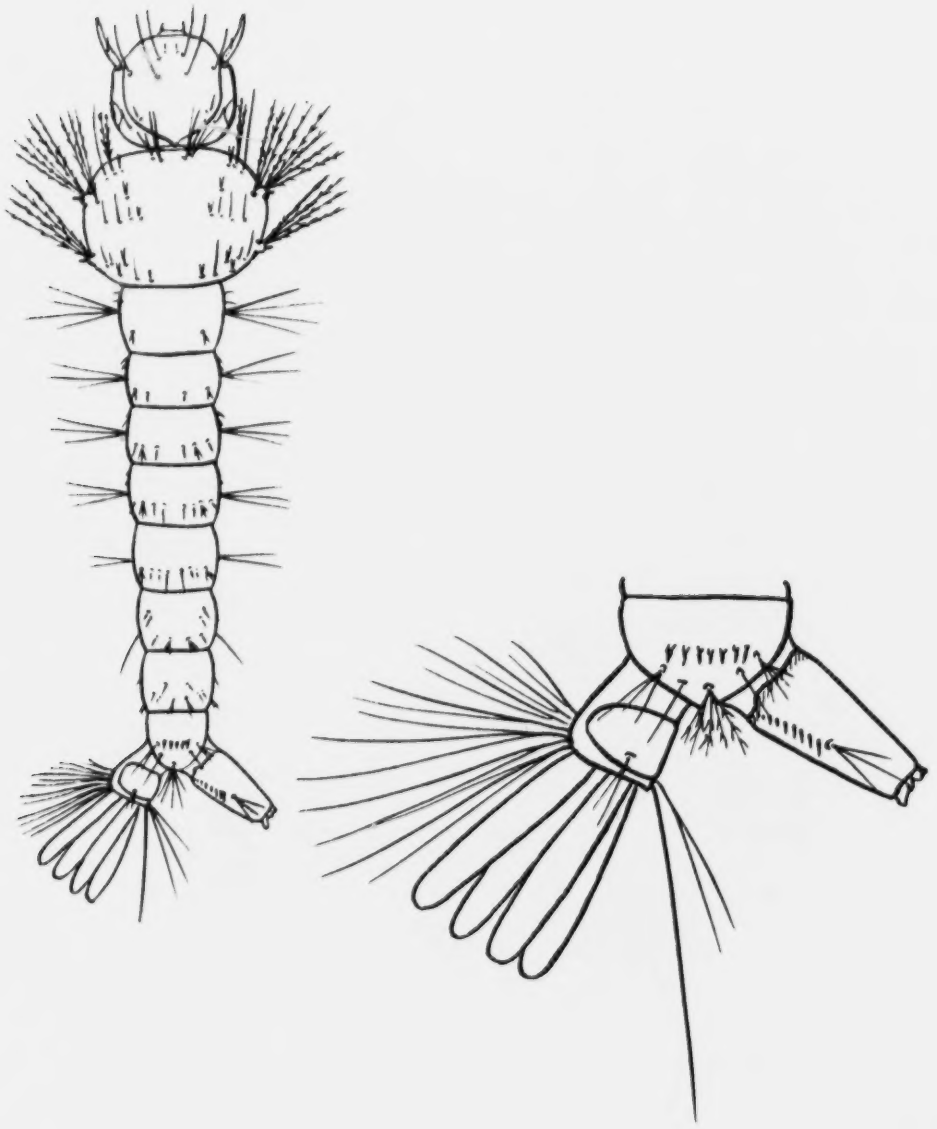


_____

name

Test yourself:

Name the genus of the mosquito larva illustrated below. Indicate by arrows the important identifying characters and label these structures.



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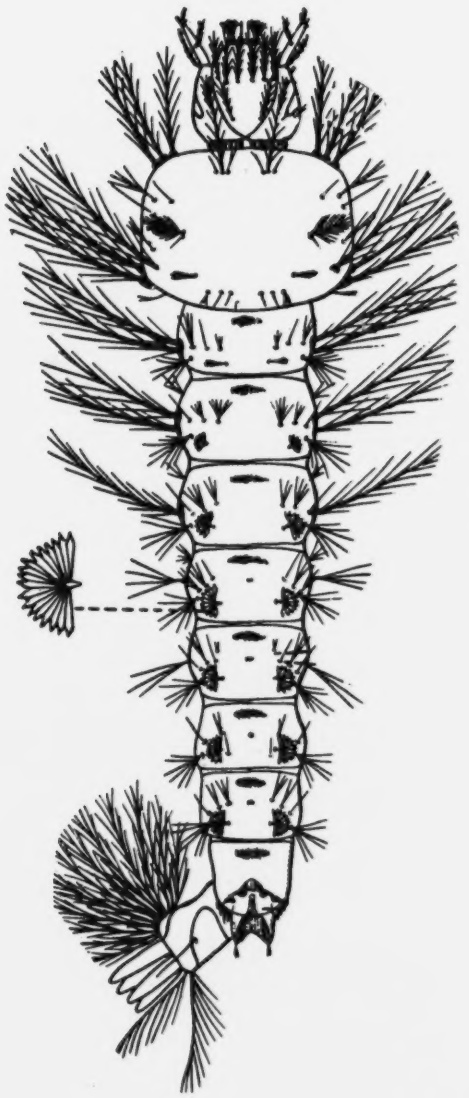
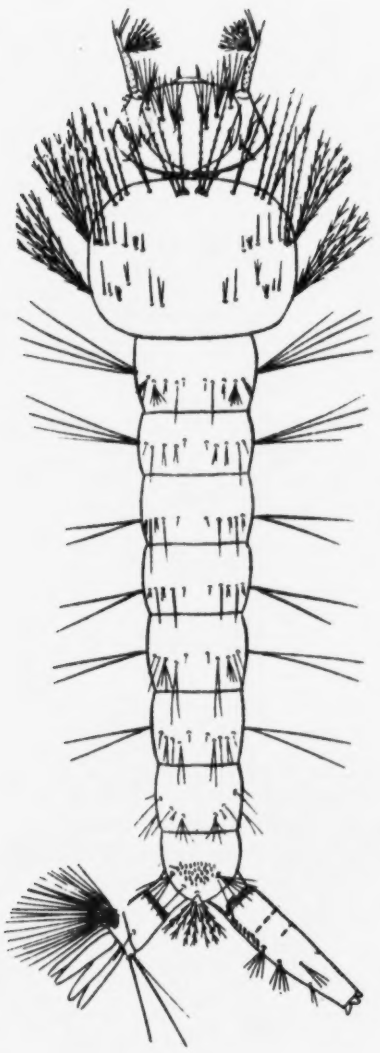


Test yourself:

Name the genus of the mosquito larva illustrated below. Indicate by arrows the important identifying characters and label these structures.



Review test:

Fill in the blanks to show that you understand what has been presented thus far.

1. The four stages in the life cycle of the mosquito:

   _____, _____, _____, _____.

2. The two main types of mosquito larvae:

   _____ or _____ larva, and

   _____ or _____; or

3. The three important genera of mosquitoes:

   the genus _____

   the genus _____

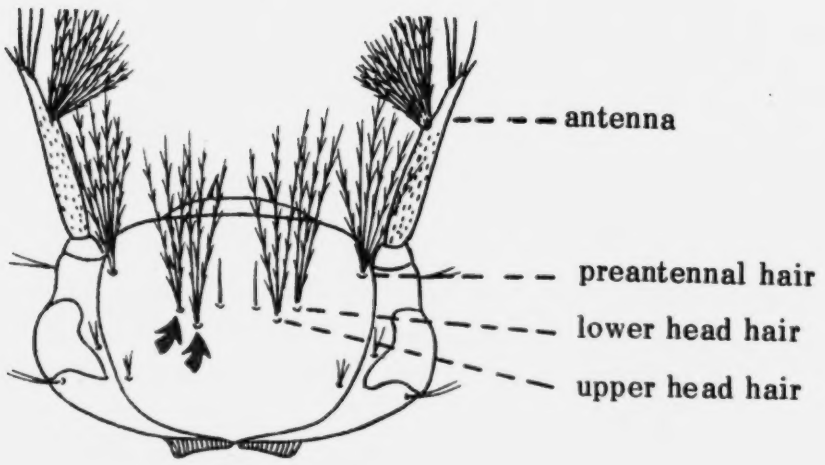
   the genus _____

Besides being separated into genera, mosquitoes are also divided into smaller groups called "species." The yellow-fever mosquito, which is in the genus *Aedes,* has the species name *aegypti.*

In identifying larvae under the microscope, additional structures that will help to differentiate *Aedes aegypti* from other species of the genus *Aedes,* and from other genera as well, are pictured and described in the following pages.

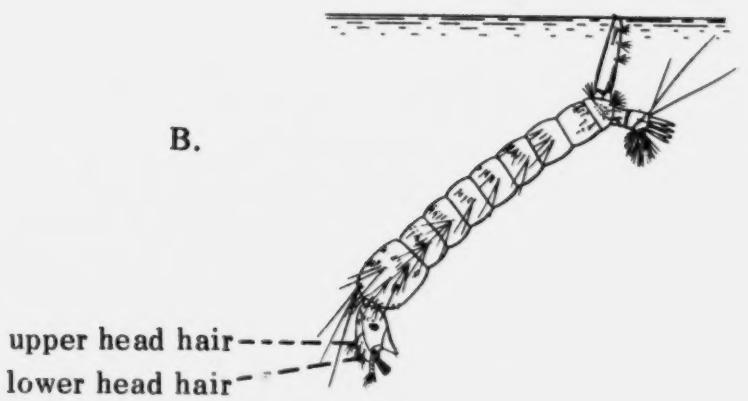
Four structures on the head of a mosquito larva are important in making an identification. They are: antenna, preantennal hair, lower head hair, and upper head hair. The preantennal hair arises from a socket near the base of the antenna.

Observe in the drawings the relative positions of the upper and the lower head hairs. In drawing A, the lower head hair appears to be in an uppermost position, but in drawing B, which shows the live larva hanging suspended from the water surface, the upper head hair is above the lower head hair.

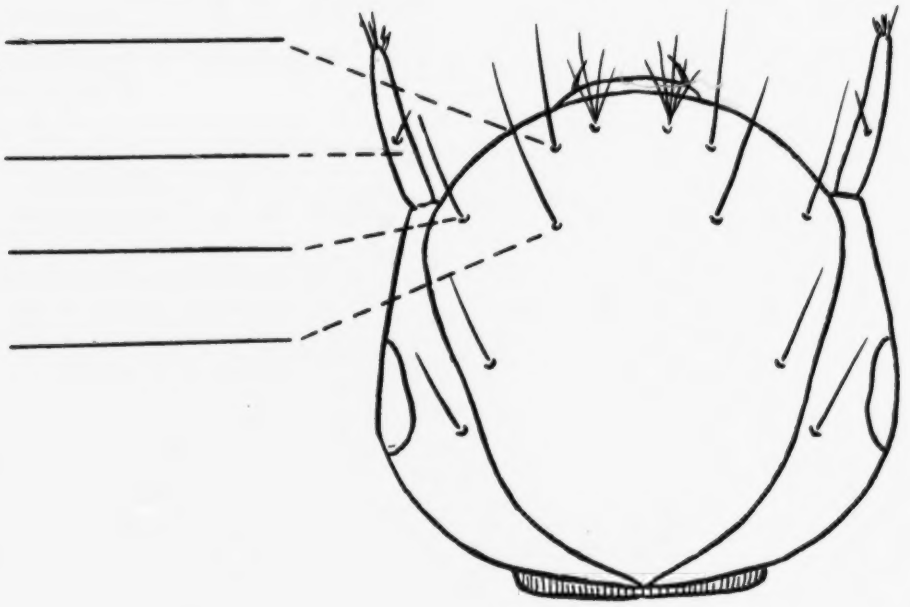


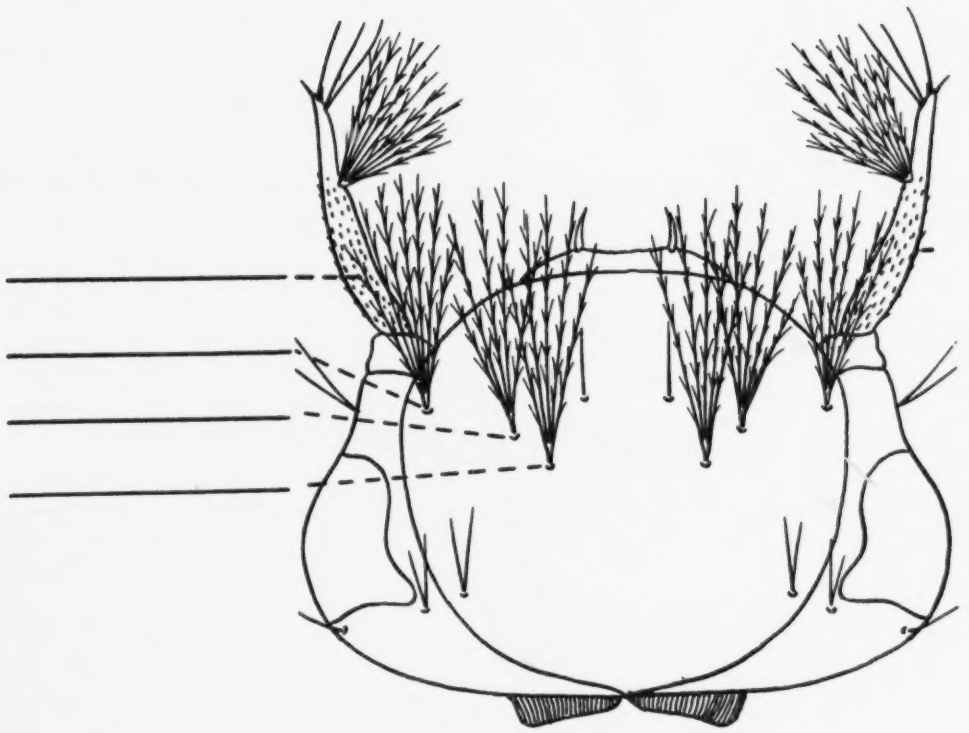
A.

B.

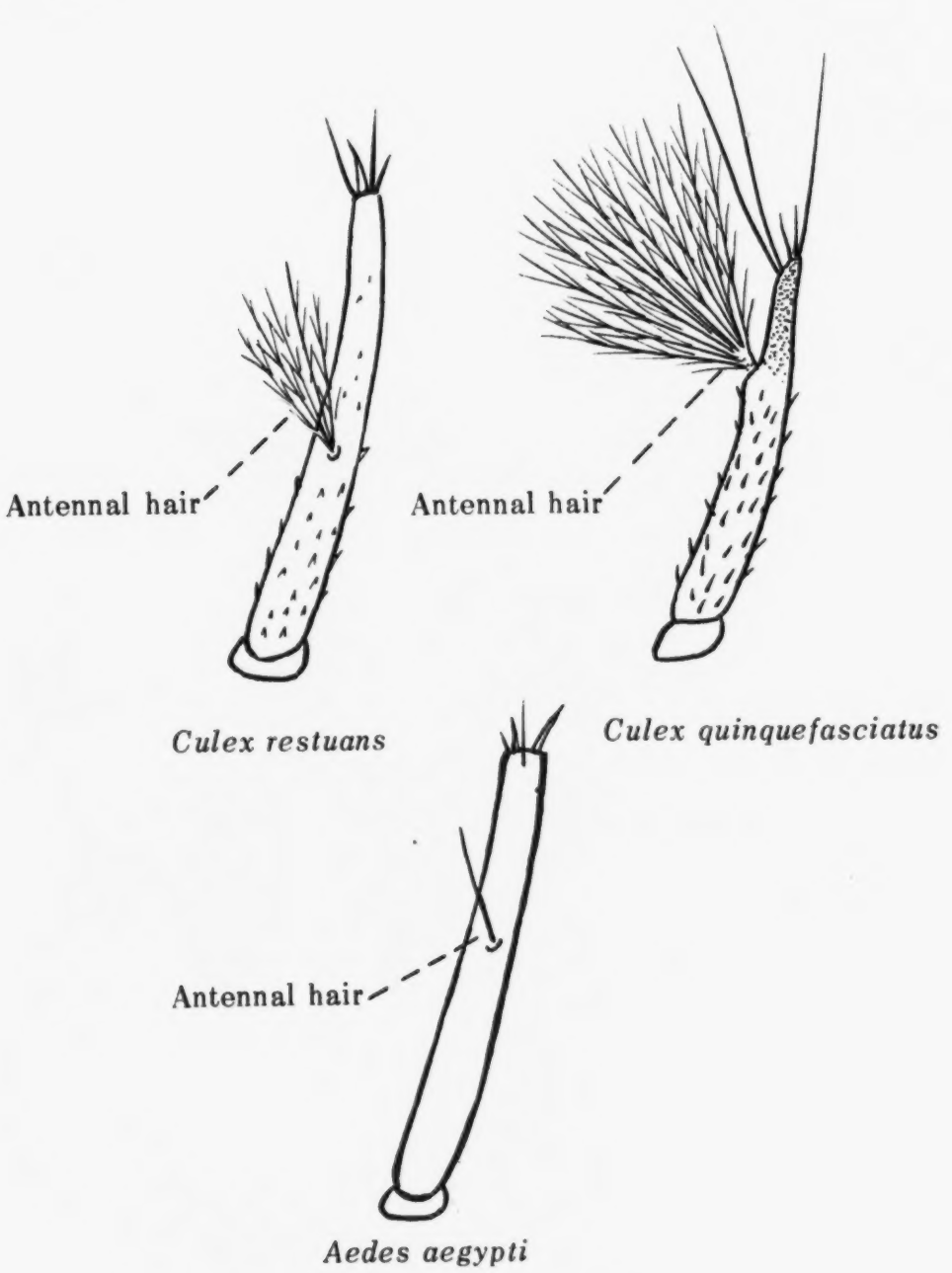


Test yourself: In these diagrams of the heads of mosquito larvae, label the four structures indicated.





The shape and structure of the antenna is important in identifying common species of mosquito larvae. The position and number of branches of the antennal hair is also important. In the drawings, note the differences in the antennae of three culicine species (*Culex restuans, Culex quinquefasciatus,* and *Aedes aegypti*).



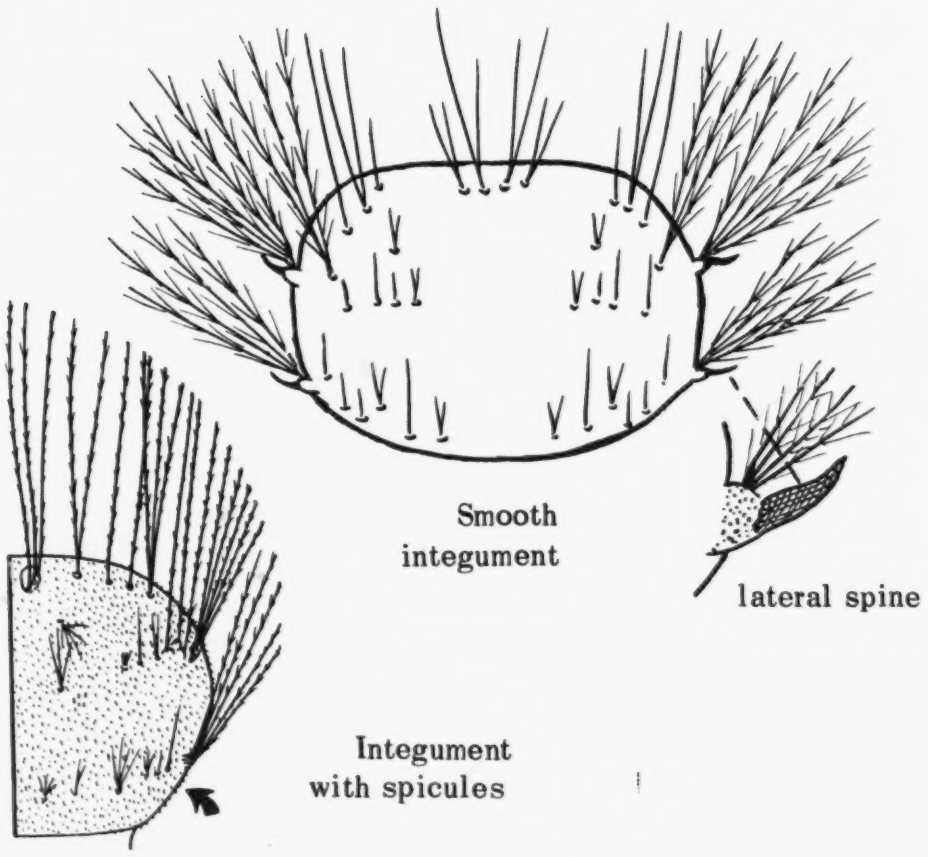
Culex restuans

Culex quinquefasciatus

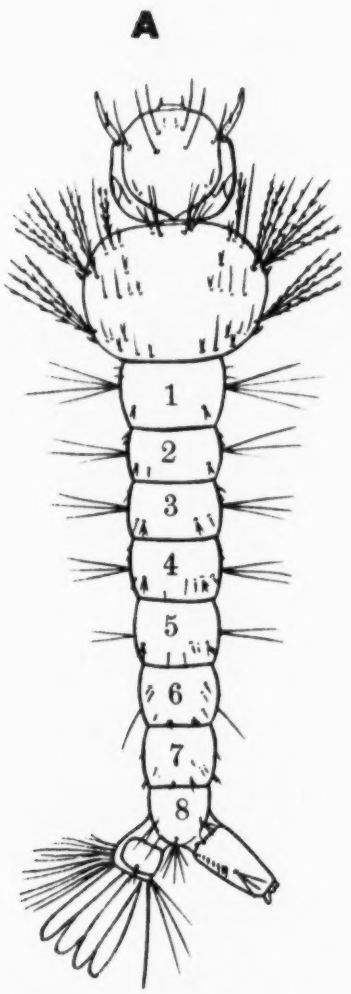
Aedes aegypti

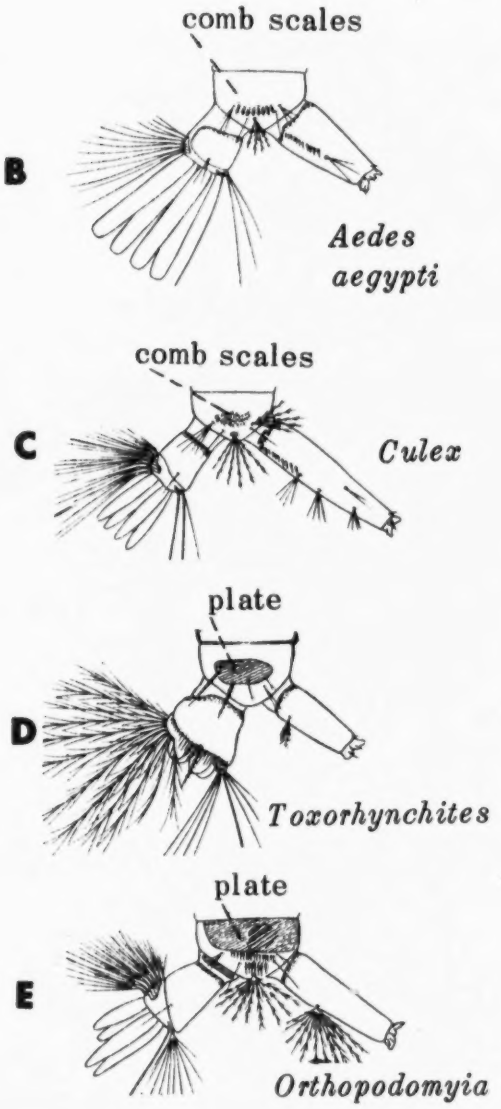
The thorax, too, bears many hairs that are used in identifying mosquito larvae. The yellow fever mosquito larva differs from most culicine mosquitoes in the United States in having four, dark lateral spines with a curved point, two on each side of the thorax at the very base of the plumose lateral hairs. The "skin" or integument may be smooth, or it may have very tiny spicules, somewhat resembling the "five o'clock shadow" on a man's face.

Aedes aegypti

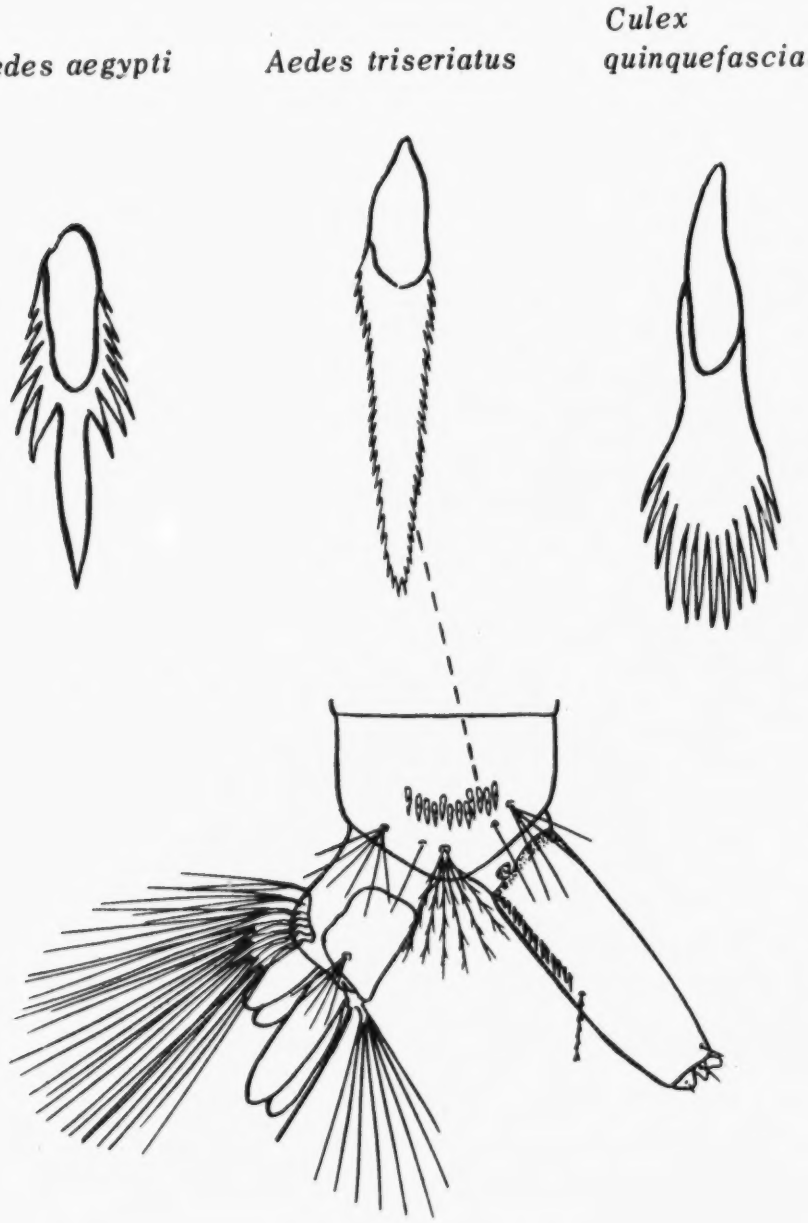


On the eighth abdominal segment (see drawings **A** and **B**) there are small structures called **comb scales,** which collectively form a comb. In some species the comb scales are few in number and are arranged in a single line, as in **B**. In other species the comb scales are more numerous and occur in a patch of two or more rows (**C**), which is known collectively as the **comb.** In some species of mosquitoes, there are lateral plates on the eighth abdominal segment, too (drawings **D** and **E**).

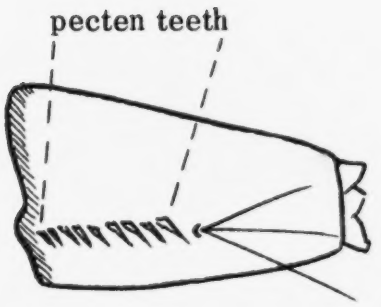




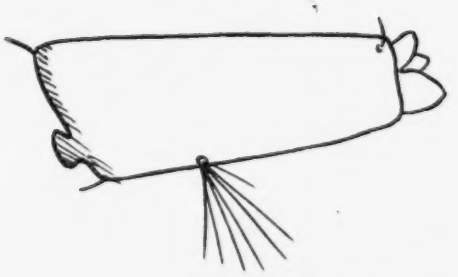
The **shape** of the comb scales is an important character used in identifying culicine larvae. The shape of three such scales is illustrated below.



The air tube is a cylindrical structure arising from the eighth abdominal segment. A comb-like row of tiny teeth called **pecten** (Latin for "comb") is present on the air tube of *Culex, Aedes,* and some other genera but absent in others.

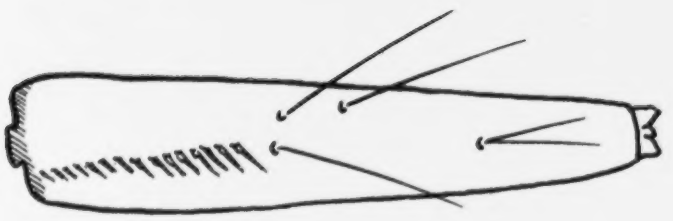


Aedes and *Culex* mosquito larvae have pecten teeth on the air tube.

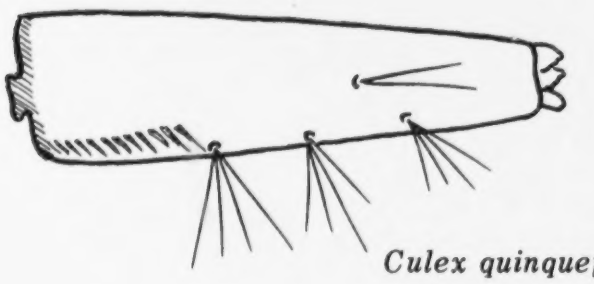


Some other mosquito larvae, such as *Toxorhynchites* and *Orthopodomyia,* do not have pecten teeth on the air tube.

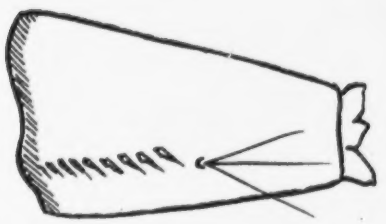
The air tube also bears one or more single hairs, or 2- to many-branched hair tufts, on each side.



Culex restuans

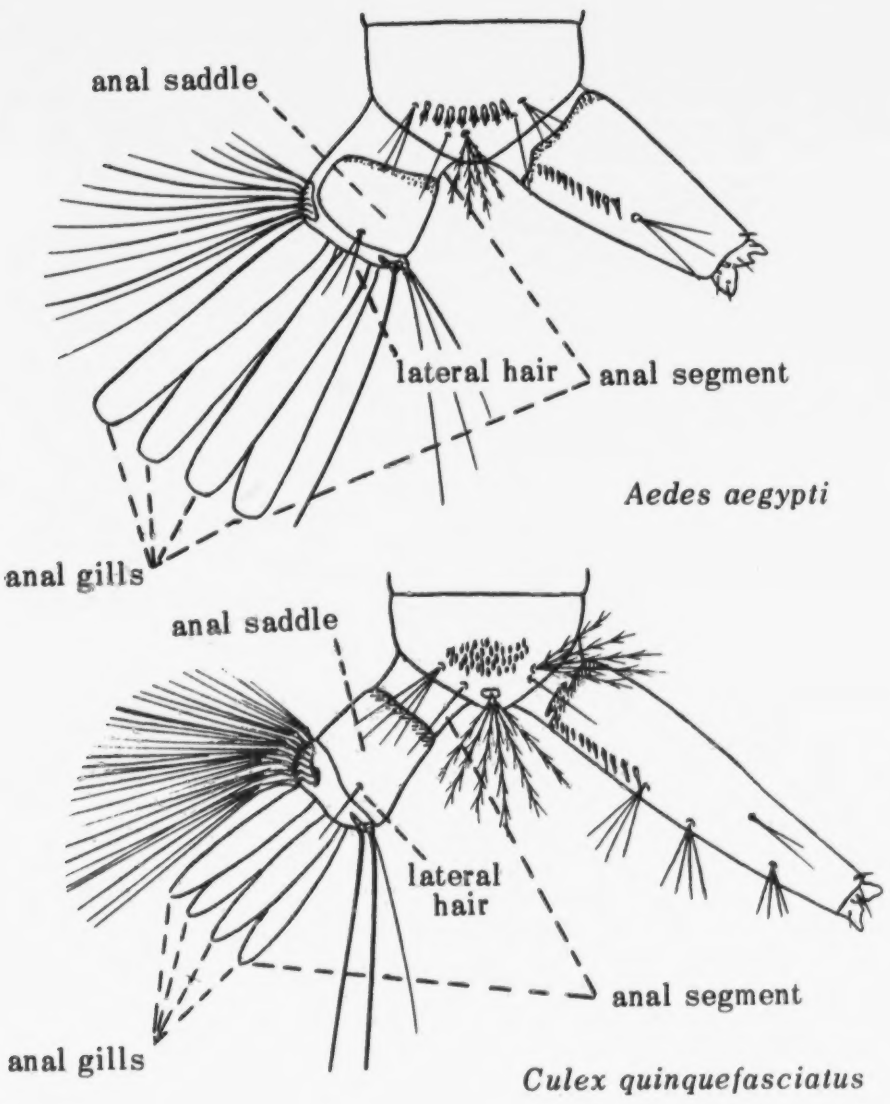


Culex quinquefasciatus



Aedes aegypti

The anal segment arises from the eighth abdominal segment. It bears an anal saddle which partially or completely encircles the anal segment. On the anal saddle there is a lateral hair which may be single, double, or many-branched. The anal segment also bears 4 anal gills which may be long or short, equal or unequal.

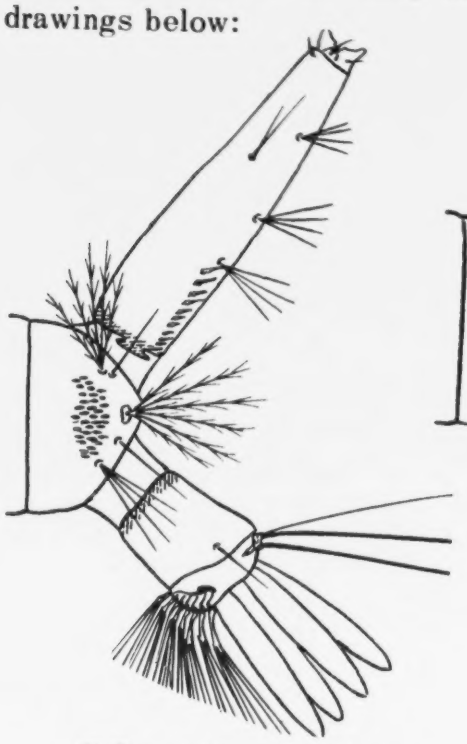


Aedes aegypti

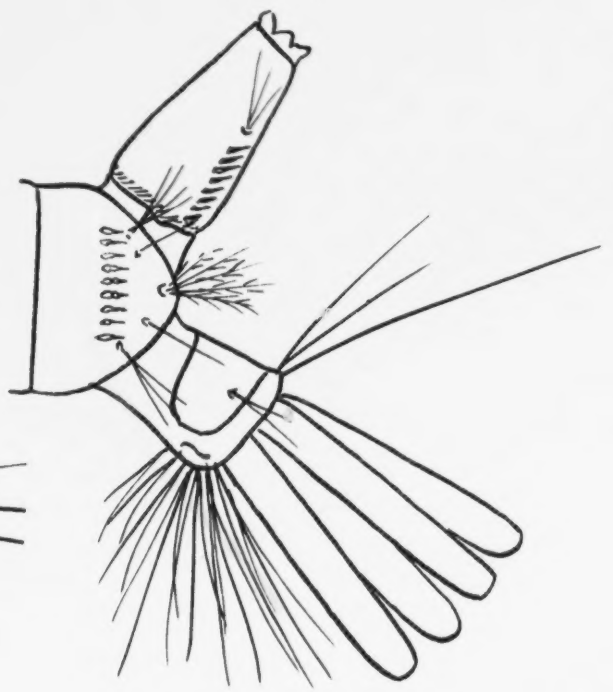
Culex quinquefasciatus

Test yourself:

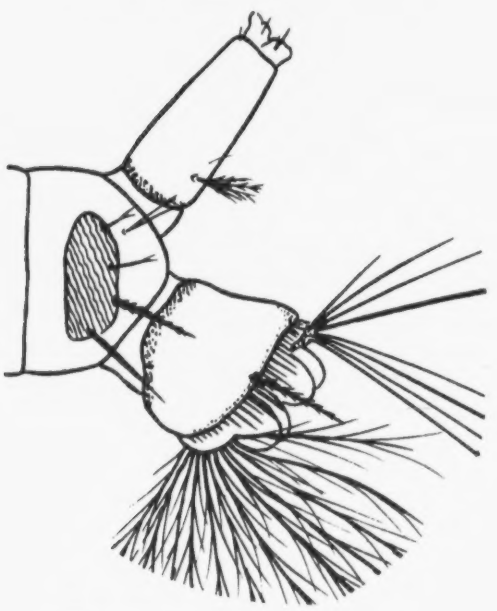
Write in the words **comb, pecten, lateral hair, lateral plate, anal saddle, anal gills, air tube,** and **hair tuft** or **hair** on each of the drawings below:



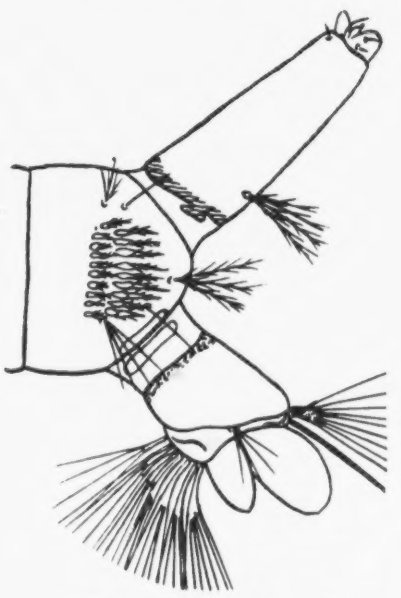
Culex quinquefasciatus



Aedes aegypti



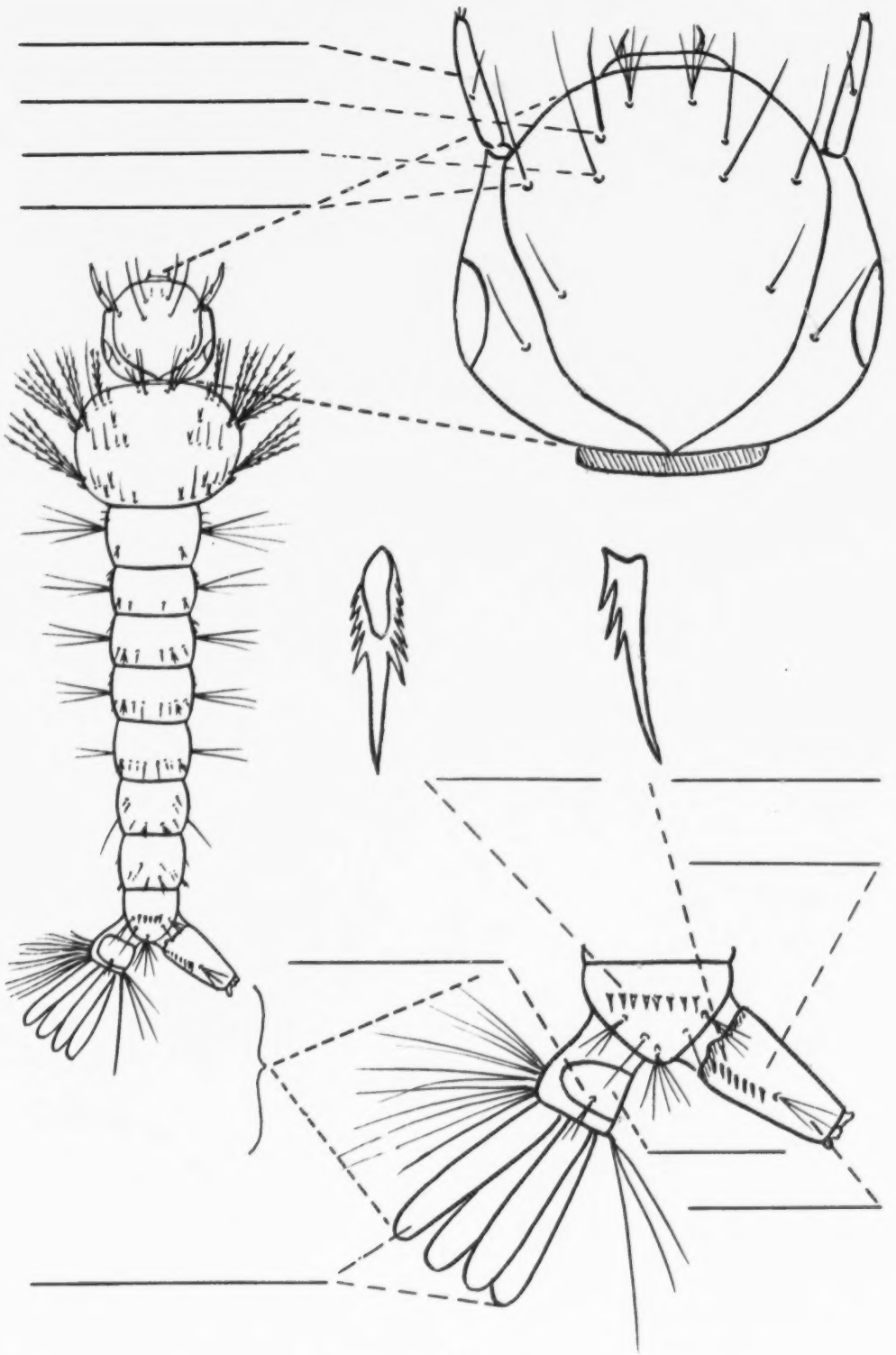
Toxorhynchites rutilus



Orthopodomyia alba

Summary Sheet

Label parts of mosquito larva



Four species of mosquito larvae are especially abundant in water-holding containers. These are

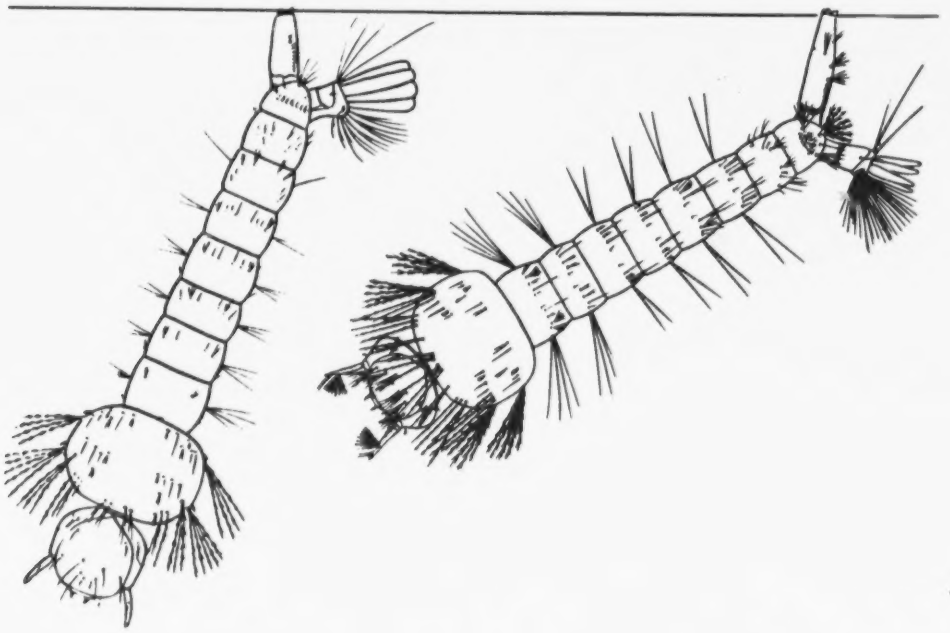
The yellow fever mosquito – *Aedes aegypti*

The tree-hole mosquito – *Aedes triseriatus*

The southern house mosquito – *Culex quinquefasciatus,*
and
Culex restuans, which has no common name.

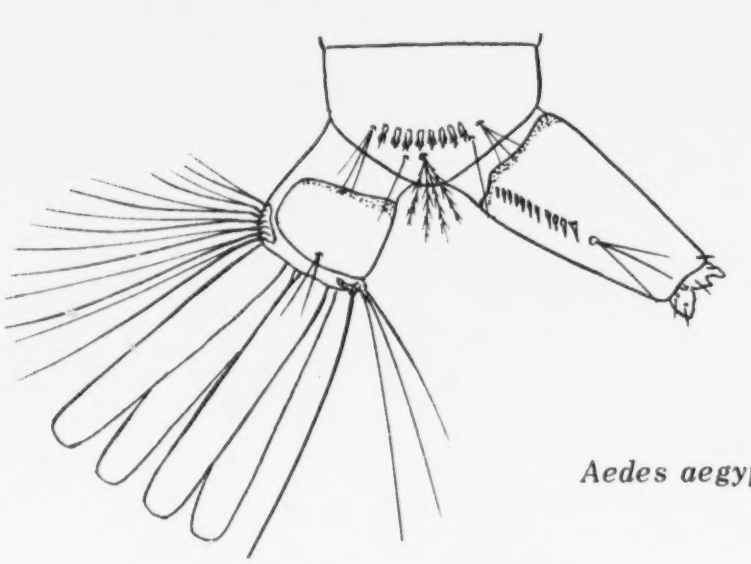
In subsequent pages, this workbook pictures and describes the differentiating characters for the two species of *Aedes,* followed by a similar treatment for the two species of *Culex.*

Aedes aegypti *Culex quinquefasciatus*

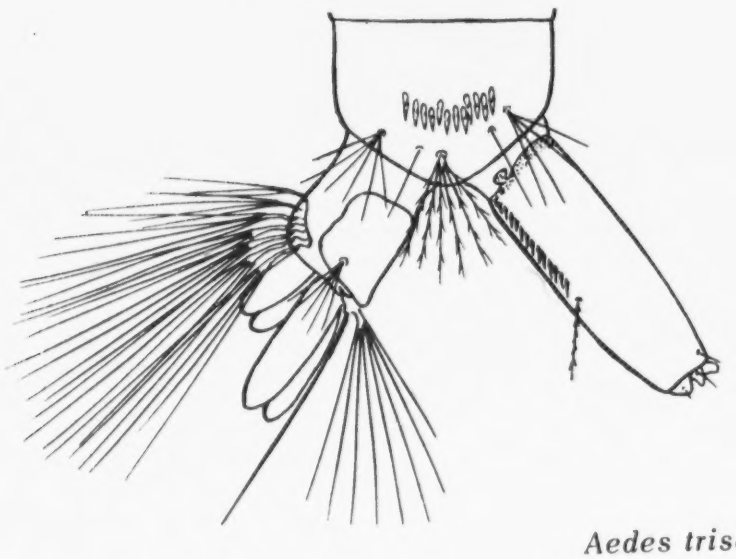


Genus Aedes

The larvae of *Aedes aegypti* and *Aedes triseriatus* are so similar that they are often confused in the field. They both have short air tubes, 2 to 3 times as long as the basal width, with a short row of pecten teeth, and one hair tuft about the middle of the air tube on each side.

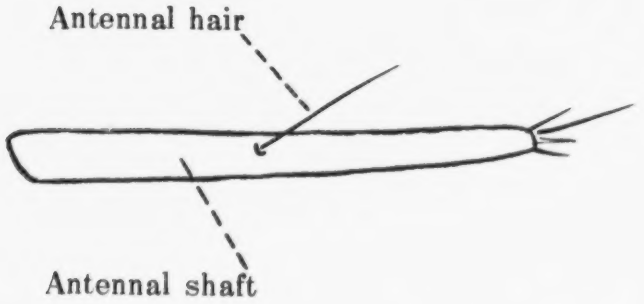


Aedes aegypti

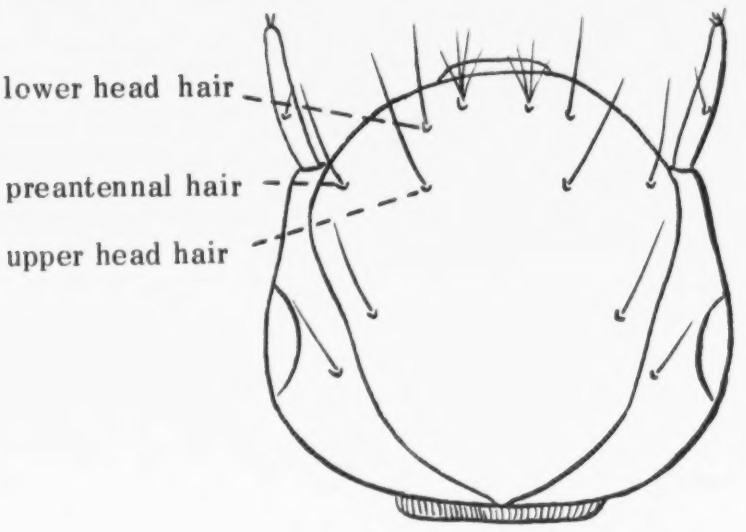


Aedes triseriatus

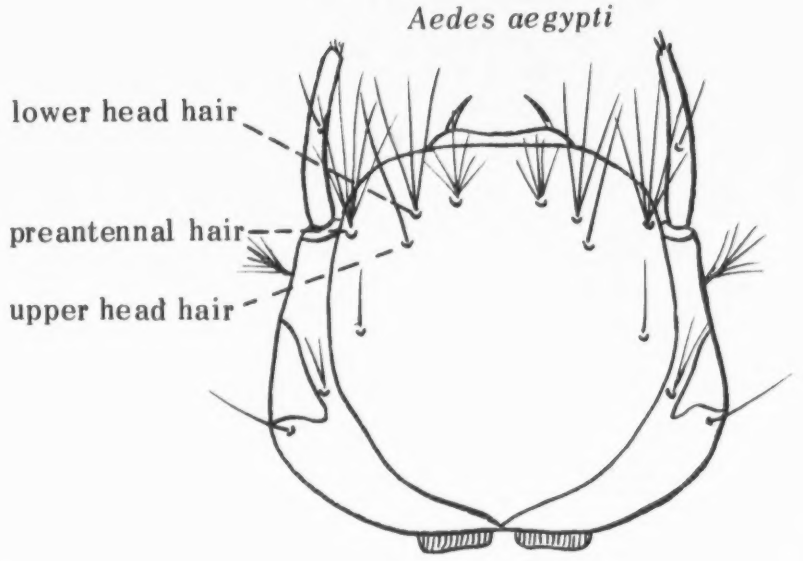
The antennae of *Aedes aegypti* and *Aedes triseriatus* are similar, with a smooth antennal shaft and a single antennal hair.



The heads of *Aedes aegypti* and *Aedes triseriatus* differ. The upper head hair, lower head hair, and preantennal hairs are all single in *Aedes aegypti,* while in *Aedes triseriatus* the lower head hair and preantennal hair have several branches.

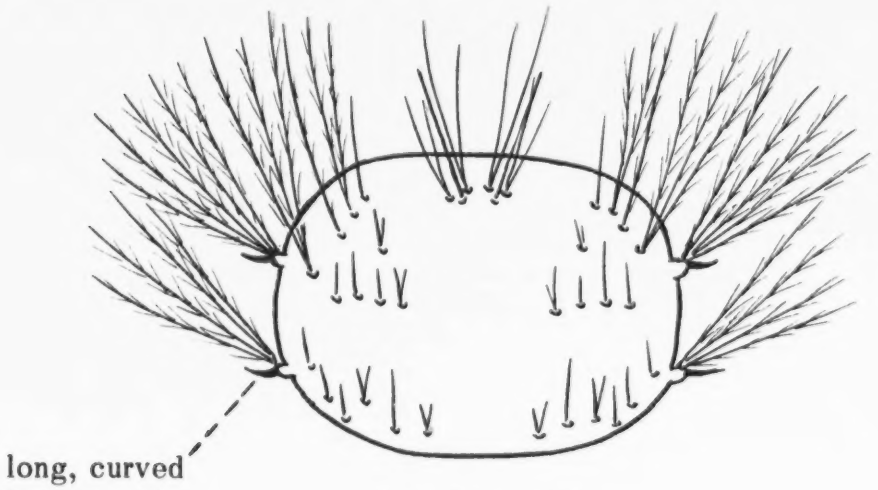


Aedes aegypti

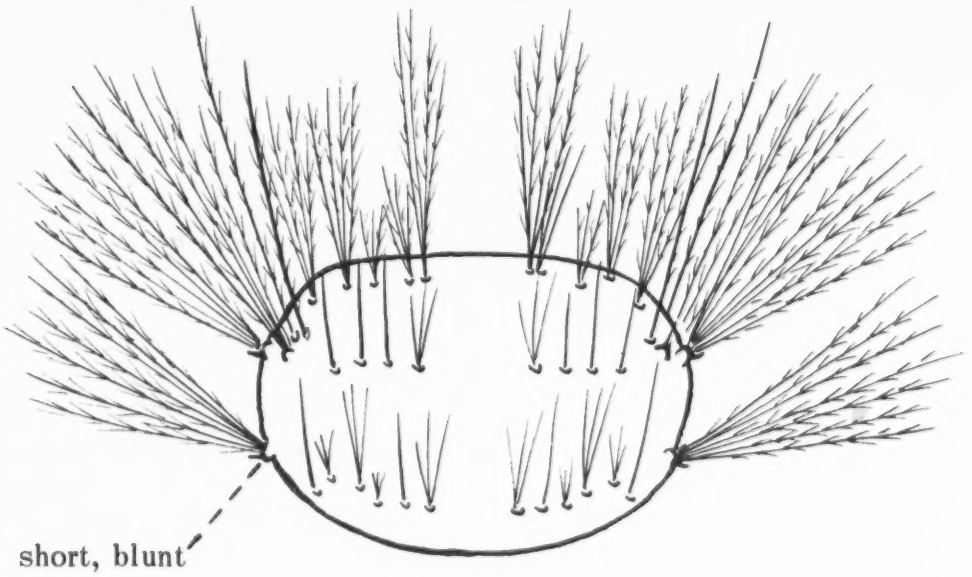


Aedes triseriatus

On the thorax there are four lateral spines at the base of the lateral hairs, two on each side, arising at the middle of the side and at the posterio-lateral angle. In *aegypti* these are long, curved, and pointed; but in *triseriatus* they are short and appear to be blunt or with a short point.

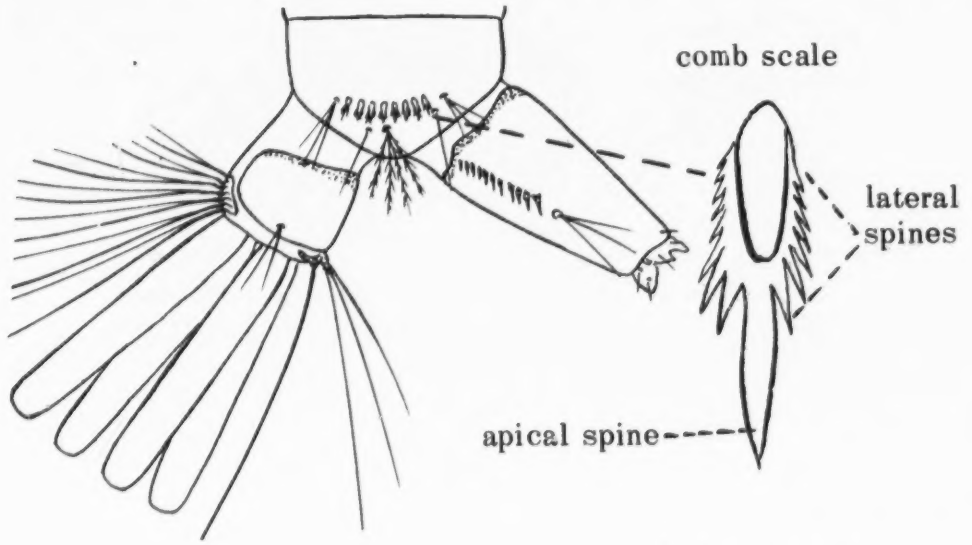


Aedes aegypti

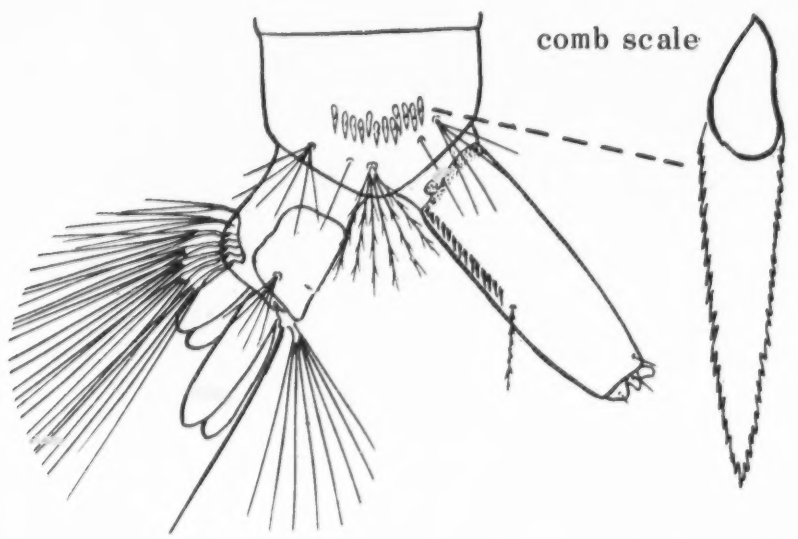


Aedes triseriatus

The comb scales of *Aedes aegypti* and *Aedes triseriatus* both lie in a single row of about 7 to 15 scales. In *aegypti* the comb scale has a long apical spine and lateral spines, whereas in *triseriatus* the comb scale lacks the long apical spine, is somewhat slipper-shaped, and has a fine fringe along the margin.

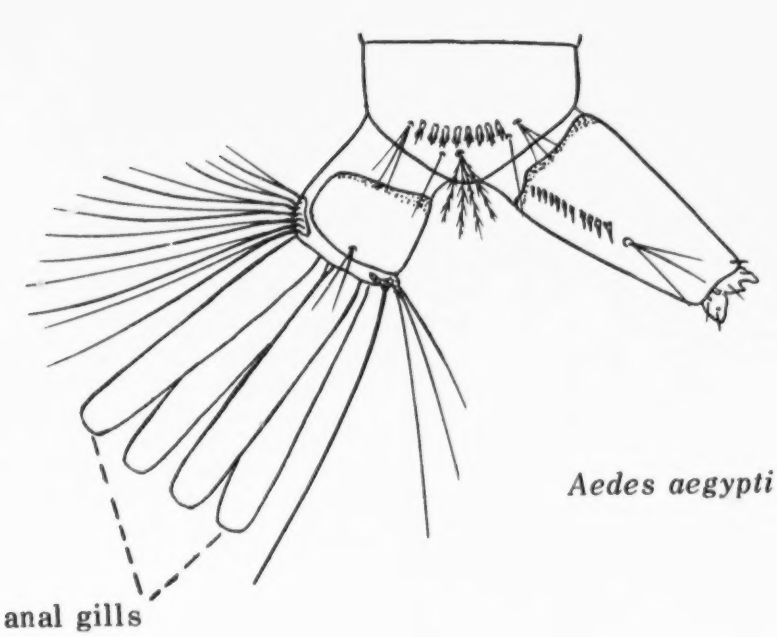


Aedes aegypti

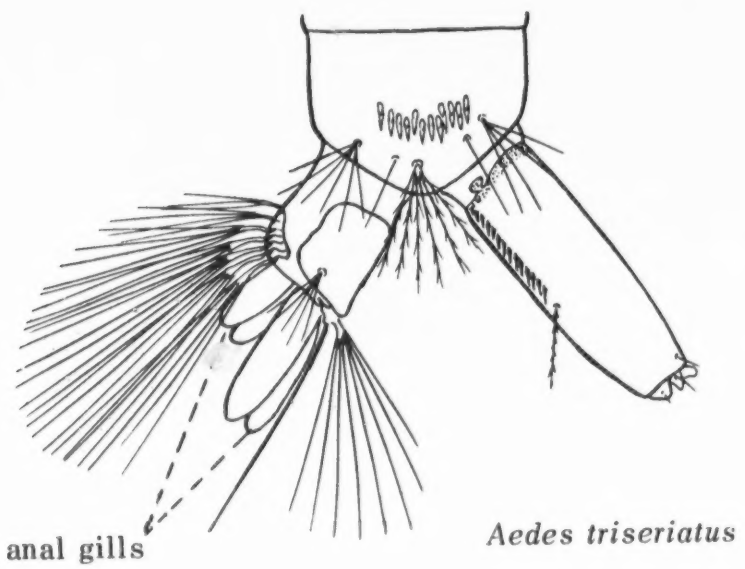


Aedes triseriatus

Good specimens of *Aedes aegypti* have four anal gills of approximately the same length, each gill usually twice or more as long as its basal width. In *Aedes triseriatus* all the anal gills are relatively short, one pair of the gills much shorter than the other pair.



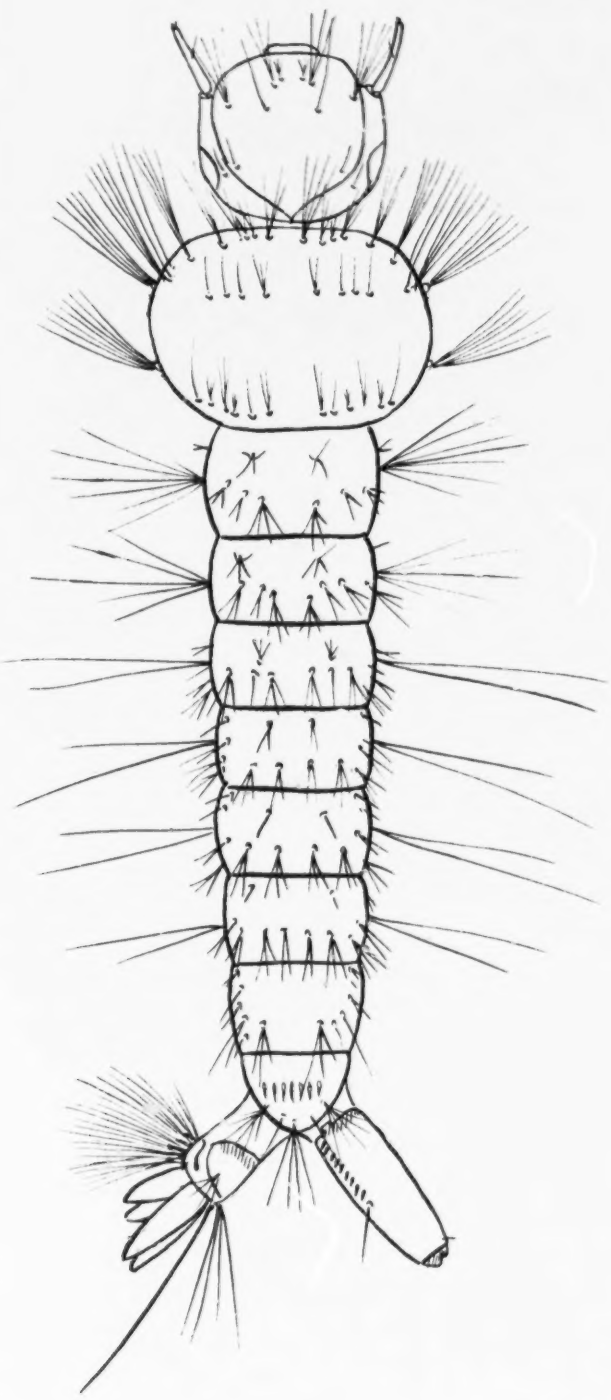
Aedes aegypti



Aedes triseriatus

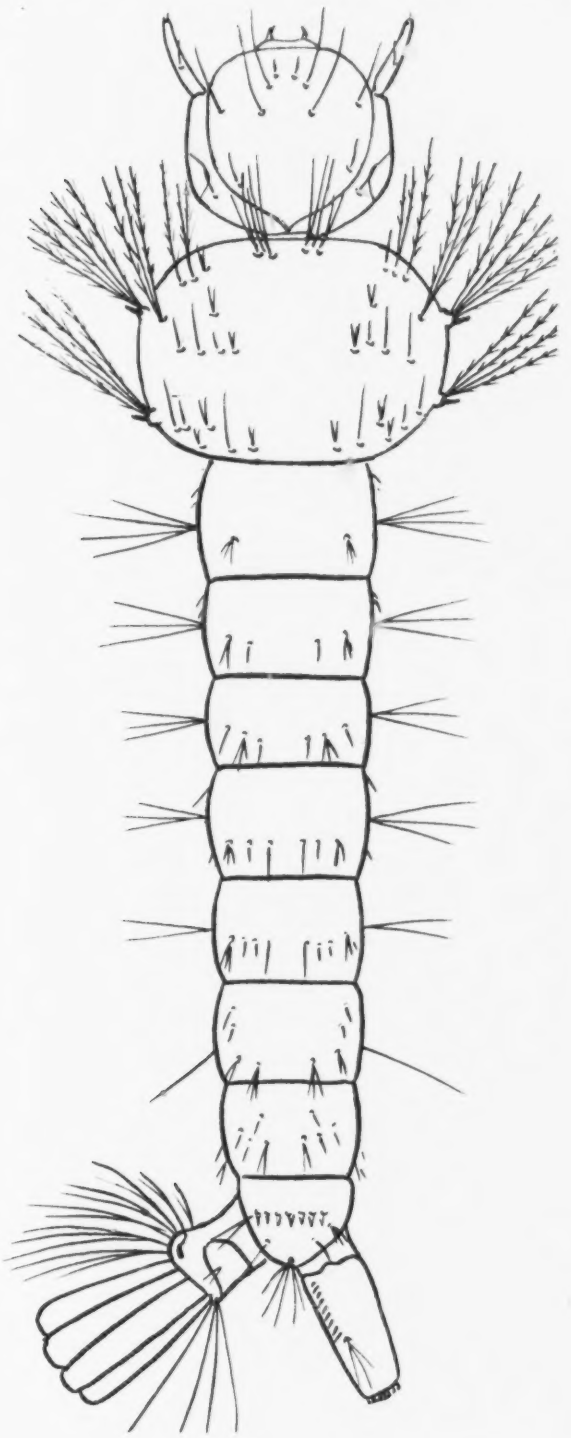
Test yourself:

Identify the mosquito larva illustrated below. What are the important identifying structures? Indicate them by arrows.



Test yourself:

Identify the mosquito larva illustrated below. What are the important identifying structures? Indicate them by arrows.



Test yourself:

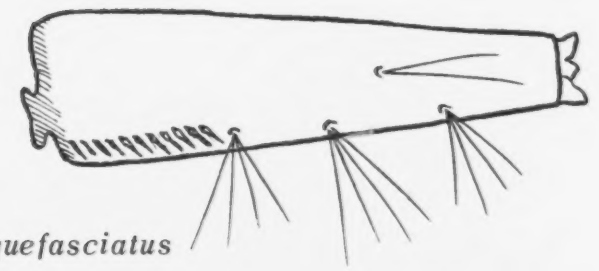
Two comb scales of *Aedes* larvae are illustrated below. From which species did scales A and B come?

A _____

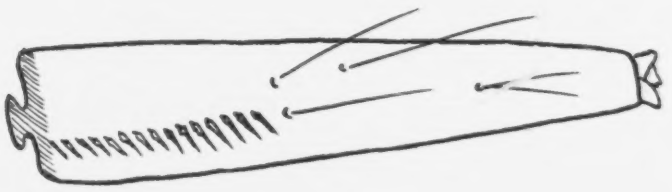
B _____

Genus *Culex*

Larvae of *Culex quinquefasciatus* and *Culex restuans* have longer tubes (3.5 to about 5 times as long as the basal width) than *Aedes aegypti* or *triseriatus,* with several long, single hairs or 2- to many-branched hairs and a short row of pecten teeth on each side.

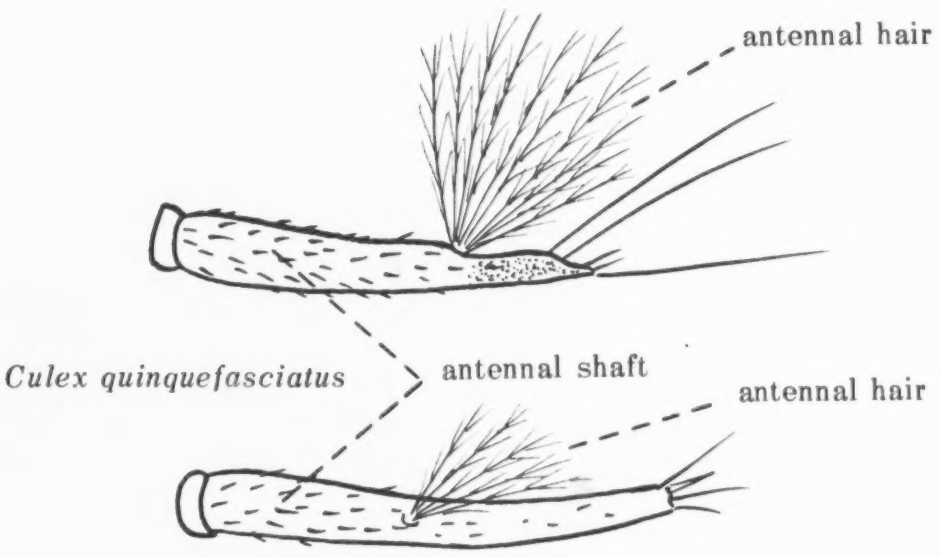


Culex quinquefasciatus



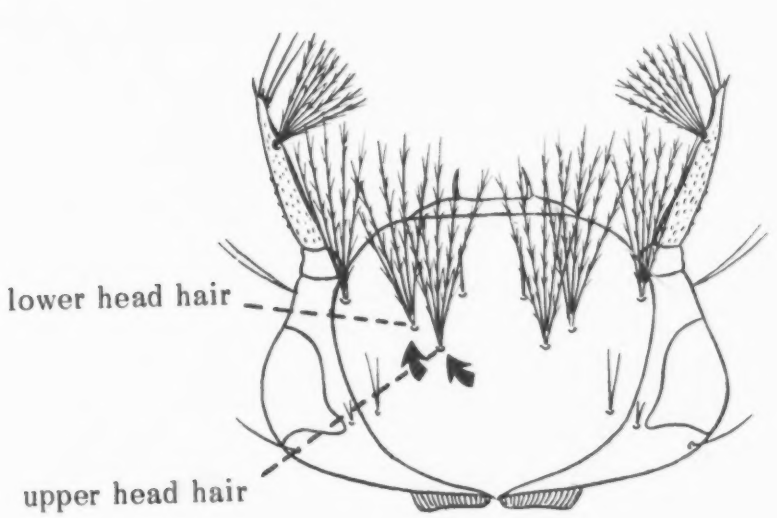
Culex restuans

The antennae of *Culex quinquefasciatus* and *Culex restuans* are longer and have a rougher appearance than those of *Aedes aegypti* and *Aedes triseriatus*. The antennal hair is about in the middle in *Culex restuans* and at the outer third in *Culex quinquefasciatus*. In *restuans* the antennal shaft tapers gradually from base to tip, but in *quinquefasciatus* it is markedly narrower in the outer third.

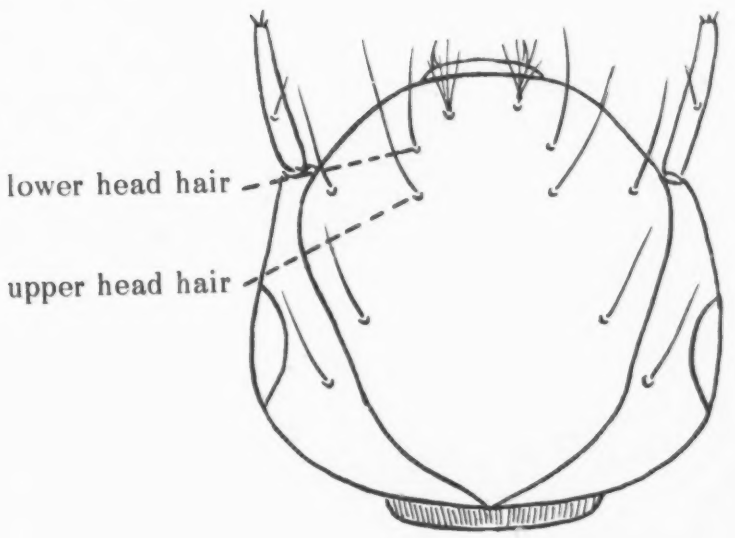


Culex restuans

The upper and lower head hairs have about 5 branches in *Culex quinquefasciatus* and *Culex restuans*. In *Aedes aegypti* and *Aedes triseriatus* the upper head hair is single.

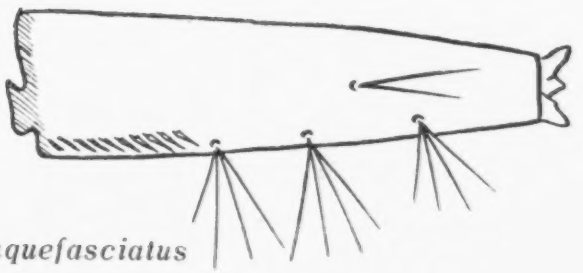


Culex quinquefasciatus



Aedes aegypti

Culex quinquefasciatus and *Culex restuans* can be readily identified by their air tubes. In *quinquefasciatus* there are normally four hair tufts, with two or more branches. The sockets from which the first, second, and fourth hair tufts arise lie somewhat in a line, and the socket from which the third hair tuft arises is somewhat out of line. In *restuans* most of the hairs on the air tube are long and single except for one which is 2- or 3-branched. The air tube in *Culex restuans* tends to be somewhat longer and more slender than in *Culex quinquefasciatus*.

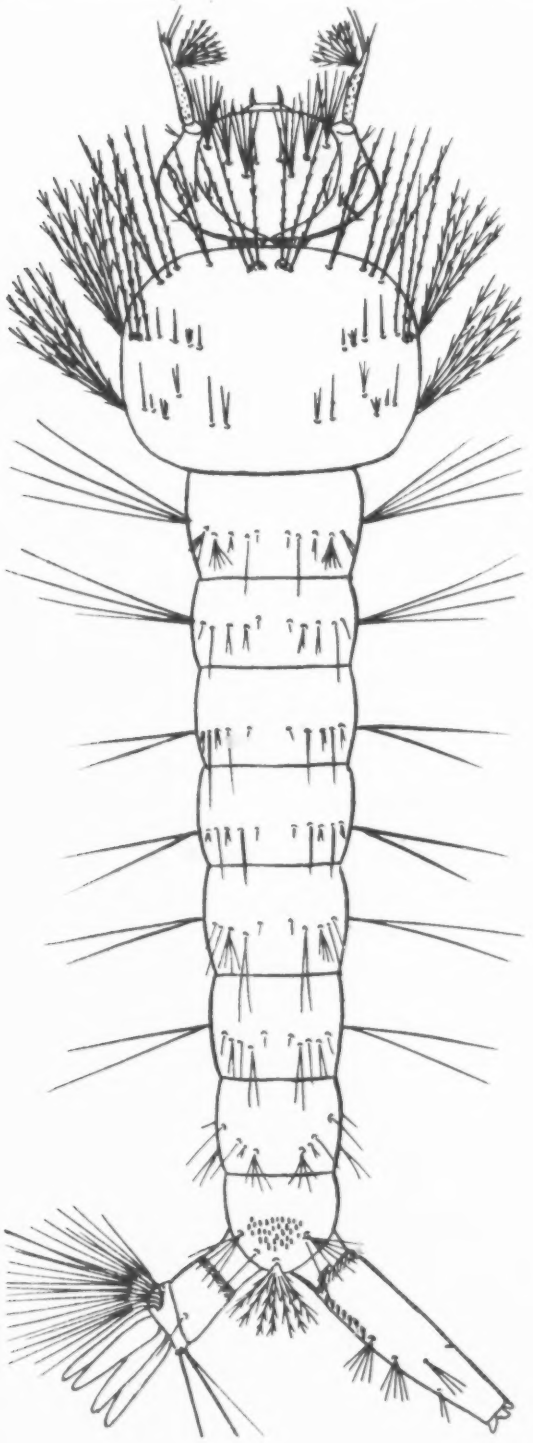


Culex quinquefasciatus

Culex restuans

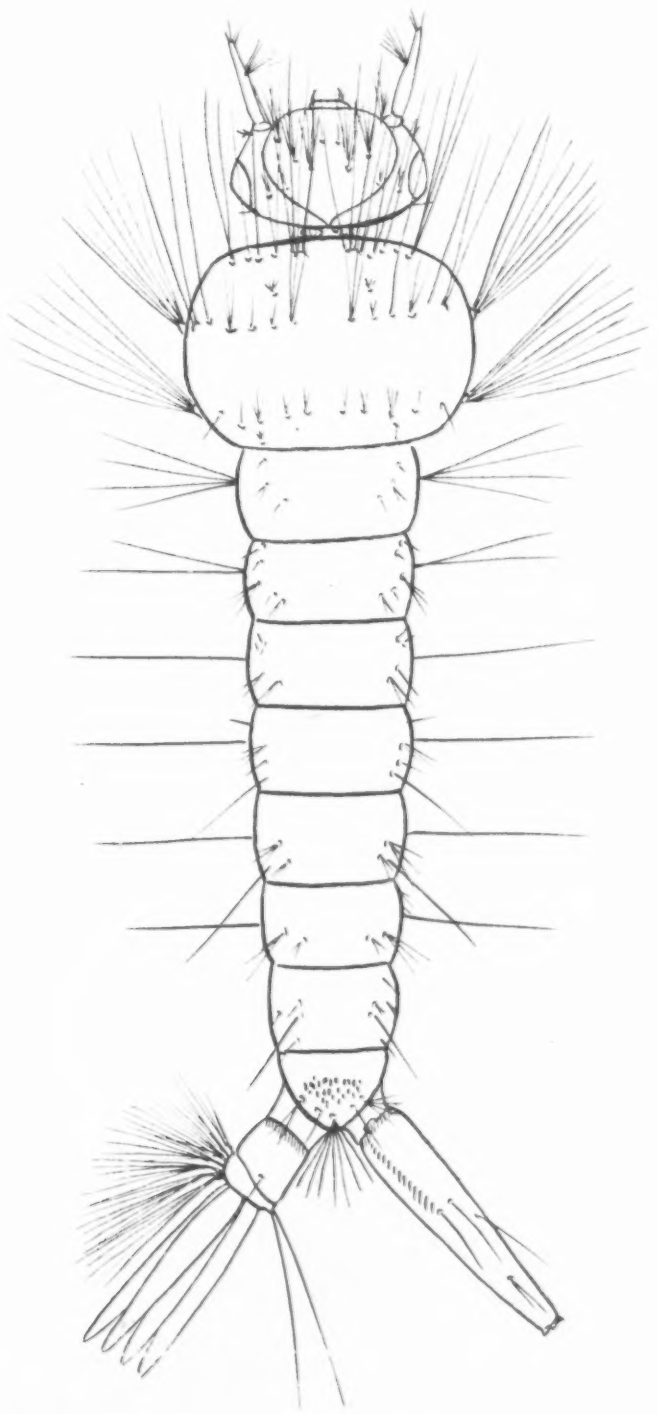
Test yourself:

Identify the mosquito larva illustrated below. What are the important identifying structures? Indicate them by arrows.



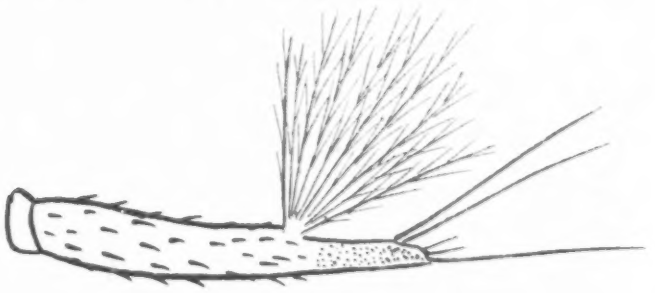
Test yourself:

Identify the mosquito larva illustrated below. What are the important identifying structures? Indicate them by arrows.



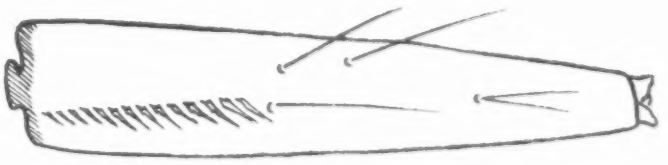
Test yourself:

The two common species of *Culex* can be easily identified by the shape of the antenna and the position of the antennal hair, or by the arrangement and number of branches of hairs on the air tube. To which species of *Culex* did the antenna and air tubes labeled A, B, C, and D, belong?

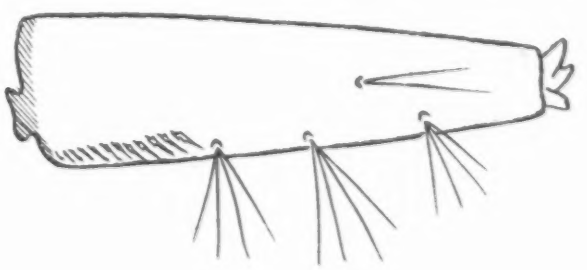


a. _____

b. _____



c. _____



d. _____

GLOSSARY

abdomen – the third major, or most posterior, region of the insect body, composed of eight segments plus the terminal segments, page 6.

abdominal segment – one of the subdivisions of the abdomen, usually referring to one of the first eight divisions of the abdomen, page 28.

Aedes – a generic name for a group of mosquitoes, meaning "disagreeable" in Greek, page 16.

aegypti – the specific (species) name of the yellow fever mosquito, literally meaning in Latin "of Egypt," page 23.

air tube – a cylindrical structure arising from the eighth abdominal segment of culicine larvae, used for respiration.

anal gills – membraneous terminal structures on the anal segment, not used for breathing as in fishes, but for maintaining the chemical balance in the mosquito "blood," page 32.

anal saddle – a hardened, or sclerotized, plate on the anal segment, page 32.

anal segment – the structure at the end of culicine mosquito larva in which the alimentary canal is located, terminating in the **anus** or posterior opening of the canal, page 32.

anopheline larva – malaria mosquito larvae, without an air tube and with palmate hairs, page 7.

Anopheles – a generic name for the group of malaria mosquitoes, meaning "troublesome" in Greek, page 9.

antenna – a tubular appendage on the head, often called a "feeler," page 24.

antennal hair – a single to many-branched hair tuft on the shaft of the antenna, **not** at the tip of the antenna, page 26.

apical spine – a spine at the tip of some part of the mosquito body, for example, the elongated central portion of a comb scale, as in *Aedes aegypti*, page 40.

aquatic insect – insect which lives in water, pages 4 and 5.

comb – a group of scales on the eighth abdominal segment, page 28.

comb scales – tiny structures arising from the integument of the eighth abdominal segment, with a characteristic shape in each species of culicine mosquito, page 28.

Culex – a generic name for a group of mosquitoes meaning "gnat" in Latin, page 16.

culicine larva – a mosquito larva with an air tube and without palmate hairs on the abdomen, includes *Aedes* and *Culex* larvae and many other genera, page 7.

head – the first, or most anterior, region of the insect body, page 6.

integument – the external covering, or "skin," of the body, page 27.

lateral hair – a hair on the side, either of the thorax, abdomen, or anal segment, page 32.

lateral plate – a hardened, or sclerotized, plate on the eighth abdominal segment, page 28.

lateral spine – a spine on the side, variously used, as for example on the thorax, or on the side of the apical spine on a comb scale, pages 27 and 40.

lower head hair – one of the hairs on the upper surface of the head, page 24.

palmate hair – float hairs on the abdomen of the malaria mosquito larva, given the name "palmate" after the palm frond, pages 7 and 8.